APRIL 1986

- MUSIC
- MICROS
- MIDI
- MULTI-TRACK

and more!

Electronic MUSICIAN

A MIX PUBLICATION

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GUITAR TO MIDI

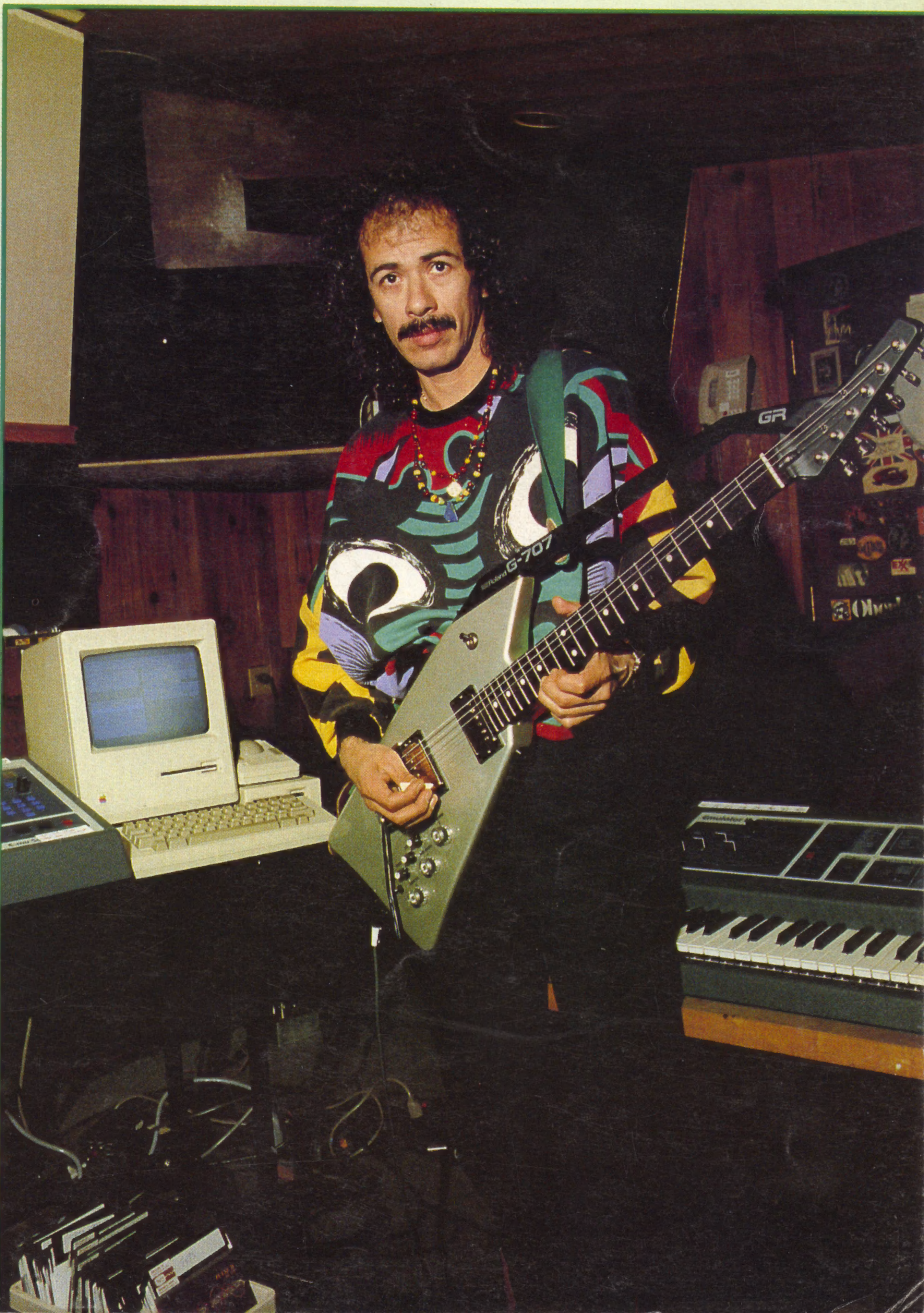
AMIGA!
Hardware and software

SANTANA'S MIDI GUITAR

Interview:
TANGERINE DREAM

MIDI projects!
MASTER CLOCK and THRU BOX

Reviews:
ECHO PLUS, MIDI WIND DRIVER



YAMAHA QX1
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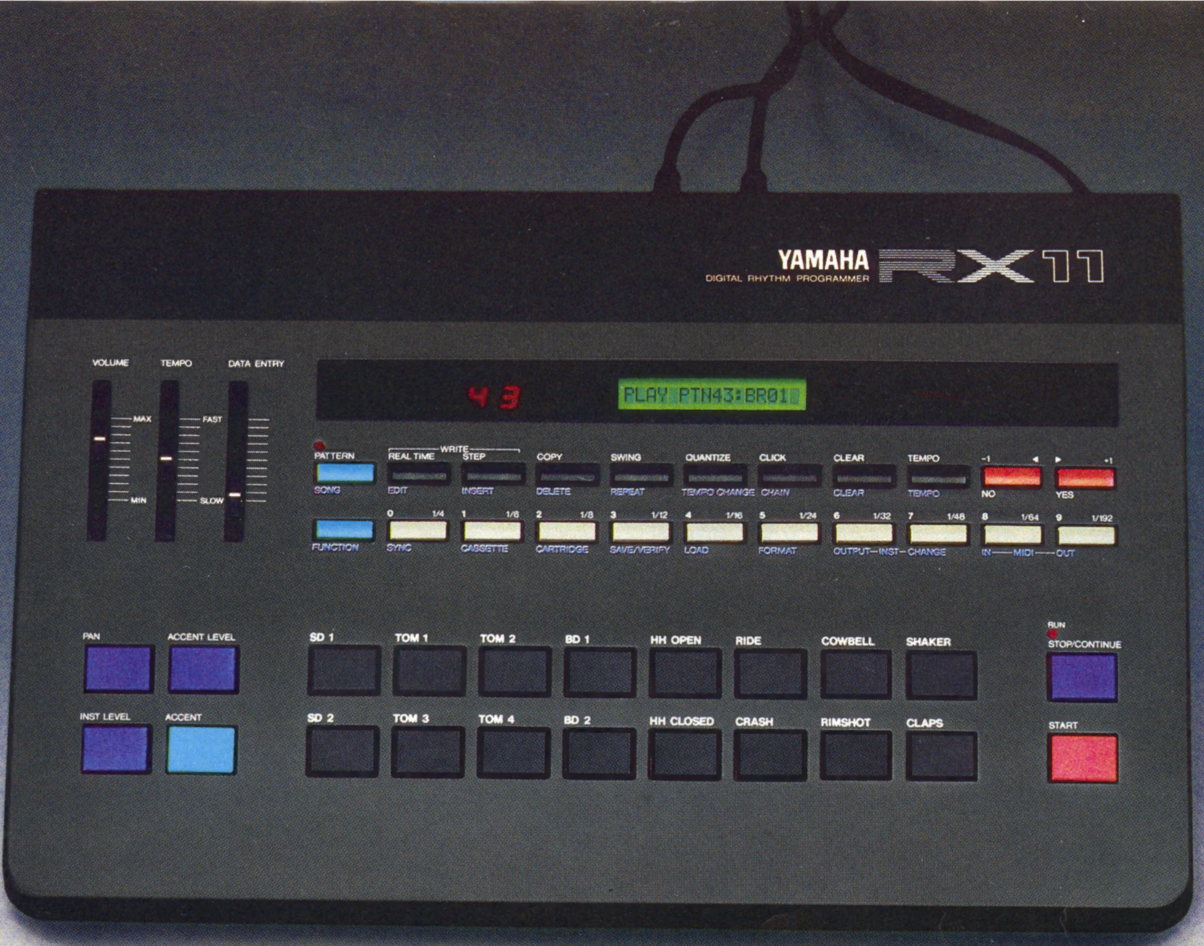
YAMAHA RX11
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MIN
FAST
SLOW
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PATTERN
SONG
WRITE
REAL TIME
EDIT
STEP
INSERT
COPY
DELETE
SWING
REPEAT
QUANTIZE
TEMPO CHANGE
CLICK
CHAIN
CLEAR
CLEAR
TEMPO
TEMPO
NO
YES
FUNCTION
SYNC
CASSETTE
CARTRIDGE
SAVE/VERIFY
LOAD
FORMAT
OUTPUT—INST—CHANGE
IN—MIDI—OUT
PAN
ACCENT LEVEL
INST LEVEL
ACCENT
SD 1
TOM 1
TOM 2
BD 1
HH OPEN
RIDE
COWBELL
SHAKER
SD 2
TOM 3
TOM 4
BD 2
HH CLOSED
CRASH
RIMSHOT
CLAPS
RUN
STOP/CONTINUE
START

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VOL. 2, NO. 4 APRIL 1986

Electronic MUSICIAN

A MIX PUBLICATION

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COVER

Trend setting guitarist Carlos Santana prepares material for his new album (working title: *Songs of Freedom*) using a Roland 707 guitar synthesizer to control his Emulator II. He and band members/programmers Chester Thompson, Sterling Crew and Bryan Bell made extensive use of the Macintosh with Opcode sequencer software and the E-mu SP-12 drum machine in preparing the album project. Photo by Randy Bachman.

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Editor's Note

NAMM, the National Association of Music Merchants, holds two conventions a year where manufacturers exhibit their latest wares to retailers, the press, and other manufacturers. Lately, there has been some debate within the organization whether or not to have a "consumer day" where the general public could have a look at what's happening in the world of musical electronics. That sounds good in theory. . .but at present, NAMM shows aren't really set up to accommodate the public.

However, at no other time has it been so necessary for musicians to see and understand products before committing the relatively large sums of money required by much of today's high-tech gear. There is a need for education, too, to bring musicians up-to-date on what changes in the industry mean to us.

Fortunately, even though NAMM will probably not have a consumer day, we're seeing more music events sponsored by metropolitan stores that do a reasonable amount of business and participate actively in the local music scene, NARAS (the National Academy of Recording Arts and Sciences) has also, on occasion, taken an active role in educational events; their digital synthesis forum in Los Angeles, for example, has been very well-received. Having two types of shows seems to make a lot of sense—national NAMM shows put on by manufacturers for their dealers, and smaller shows put on by dealers for their customers.

As one example of what this kind of regional show should offer, one extremely good prototype is the Musicom convention, held each year in the Netherlands. Holland is about the size of Los Angeles, so the comparison to a regional show in the U.S. is apt. Musicom traditionally includes both manufacturer's booths and educational booths and lectures. Although this means donating space to the educational exhibits, thus increasing the rates slightly for the space that does remain, the commercial exhibitors are willing to pay a bit more in order to underwrite some consumer education. For example, this year **EM** author Terry Fryer gave some excellent talks on sampling, Tom Metcalf (from Ensoniq) explained how to get good samples with the Mirage, and I held down a booth where I answered questions about MIDI, SMPTE, synchronization, and occasionally, sampling. The Steim electronic music research center from Amsterdam also had some displays, as did several other people and organizations. Felix Visser, Musicom's organizer, makes a point to have people such as myself—who are not affiliated with any particular manufacturer—available to answer questions on a wide range of topics, not just a particular product or family of products.

If regional shows catch on, I think they should consider the same kind of mix of commercial and educational exhibits as Musicom. And having some guest lecturers, especially from other countries, would be great—there is a lot of interesting research being done at universities here and overseas, and we should build as many bridges as possible between all concerned. The end result of throwing out concepts into the middle of a trade show is simple: it stimulates discussions of *concepts* as well as hardware.

A public day at NAMM? No, I don't think so. . .it's already crazy enough as is. Regional shows? Yes. . .but if we're going to do them, let's do them right. The more we put back into this whole musical scene, the faster it will grow.

Electronic
MUSICIAN

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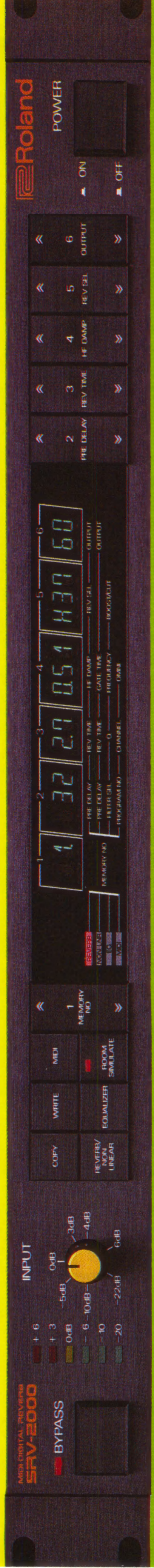
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DIGITAL SIGNAL PROCESSING FROM ROLAND

(In the fast-paced world of computers, changes and new product introductions occur on an almost daily basis. During the time since Dave Kusek wrote "Choosing a Computer for Musical Applications" for the January issue of **EM**, several developments have occurred. One is the emergence of software (such as the packages from Hybrid Arts) for the Atari 130XE, a low-cost competitor to the C-64 and similar systems. There has also been an explosion of musical software for the IBM PC along with substantial price cuts on IBM "clones," and Yamaha's CX5M continues to evolve. Several readers wrote in to fill us in on the latest news; for more information, catch our features on the IBM PC in the May issue and on Atari computers in June. We will also be doing a feature on the CX5M computer sometime this Fall—Editor.)

IBM PC Update

David Kusek's article was most interesting, but I'd like to make your readers aware of a number of recent developments. As of early January 1986, there are now at least eight PC sequencer programs (Personal Composer, Sequencer Plus, Texture, MIDI Ensemble, Inspire 1, Pro MIDI, MPS, and Syntech's new program). Of these, Pro MIDI is unique in that it is the first program to record direct to disk, providing some 1.5 million notes of instantly accessible music with a 10 Megabyte hard disk. In addition, if power is cut off in the middle of composing, only the last five seconds is lost—everything else is saved, which is a very convenient feature.

As for IBM compatibles, the Amqute portable weighs only 26 pounds and includes dual disk drives, built-in 9-inch amber monitor, 704K RAM, and a one year warranty on parts and labor. While initial reports were that it would not boot "Sequencer Plus," I tested a demo at Freff's Ffactory and it performed without a hitch.

Lastly, Octave Plateau is releasing a MIDI Patch Master program in February that performs numerous programming functions and eliminates the need for individual librarian programs for each make of synthesizer; it will be priced under $100. As far as I'm concerned, IBM compatibles are looking better than ever!

Otto von Ruggins
Brooklyn, NY

IBM PC Clarification

Dave Kusek is correct in saying the IBM PC is a "sort of" 16-bit computer, but I'd like to clarify matters somewhat. The 8088 CPU used by the IBM PC and PC/XT has an 8-bit data bus and a 16-bit address bus. Also, the 640k conventional memory barrier may now be exceeded by software implementing the "Lotus/Intel/Microsoft Expanded Memory Specification." This allows an additional 8 Megabytes for program(s) and data. See the January 14, 1986 issue of *PC Magazine* for in-depth information and reviews of memory boards.

Allan Tamm
Bellevue, WA

CX5M Update

The CX5M computer has undergone several changes recently. The "partially functional" interface mentioned in Dave Kusek's article will be replaced with a fully functional one this year, and retrofits will be available. The SFG-05 module with MIDI In will be four-voice multi-timbral, with each voice assignable to a different MIDI channel.

There is still not a lot of software available, but I feel the existing software is so good that it may be all you need. The MIDI recorder has many of the functions of the QX-1 and costs about $50. The note capacity is conservatively rated at 3,500 notes, about the same as many sequencer packages for 64K computers. It comes in cartridge form, so the computer RAM is free for note storage and no disk drive is required. The CX5M can use either an MSX or Epson printer, and the disk drive is coming soon, but I find the cassette interface to be reliable and fast enough that I will probably not buy a disk drive for some time.

Although the CX5M was described as a "closed system," it has plenty of expansion ports for all the usual peripherals, and there are now hundreds of software titles available (including word processors and spreadsheets) from NYRAC in Montgomery, AL, and the many dealers they are supplying. Finally, I feel the user manuals that come with the computer and related programs are excellent.

Our User's Group (not affiliated with Yamaha) has over 500 voices in our growing library for the CX5M along with lots of other data and printed information, all free to members. Those interested in more information can contact me at the address below.

Mike Dwyer
CX5M User's Group
5218 Scott St.
Torrance, CA 90503

Cassette Interface Comments

The first issue of **EM** looks pretty great. Bravo! Since you are interested in reader feedback, here's some on the "Exalted Cassette Interface" article.

I have been using Radio Shack CCR -81 and -82 Data Recorders ($50 and $60) for some time now with regular audio grade tape (even cheap stuff) with no glitches. Everything verifies on the first try unless the tape is absolute, dropout ridden trash. Those recorders seem to provide more output with less distortion than even expensive consumer grade recorders. In fact, I had tons of trouble with an expensive (about $100) recorder even when using good tapes. The CC-82 includes a light that indicates data (or other signal) and allows you to turn the speaker on and off while loading data (so you can hear what you have without having to make the mod suggested in the article). It also has a remote defeat switch so you don't have to pull the micro plug out to fast forward and rewind. I realize the article was about optimizing conventional audio recorders, but if you can afford a new machine I consider these little data recorders well worth the investment because of their reliability. About the only drawback is lack of a microphone for voice IDs of saves, but you could build a switcher/preamp to feed voice into the data input if this is important to you.

Tony Thomas
Los Angeles, CA

The Total Story on Total Music

We were very pleased to see Kirk Austin's excellent review of our Total Music system in your January issue. Kirk obviously spent an extraordinary amount of time with the system; his is among the most thorough and accurate reviews of any computer-music system that we've encountered.

We would like to clarify one point, however, that was raised by the illustration of the program's notation capabilities on the first page of the review. Musicians who are concerned about notation might be scared away by the example, which shows a string of intervallic seconds where there should be separate notes. The reason for the problem is that while the sequence Kirk chose to display consisted primarily of 16th notes (I know—I created that sequence file, and it's included as a demo on the program disk), he selected a notation resolution of eighth notes. The program's notation routines will not print any note lengths shorter than the selected resolution; if there are notes in the sequence that are too short, the program will approximate their position to the nearest time interval determined by the resolution. Hence, with "eighth note" selected, a pair of 16th notes will show up as a two-note chord, while a group of four 32nd notes will be displayed as a four-note chord. This problem can easily be avoided by choosing a notation resolution appropriate to the recorded sequence.

Otherwise, we owe you our thanks for a fine review, and congratulations on the magazine's new format. We know from the response to Total Music that computers are going to revolutionize every aspect of music production, and we're sure that **Electronic Musician** will be an important part of that revolution.

Paul D. Lehrman, vice-president
Southworth Music Systems
Harvard, MA

Hex Pickups

I'd like to try a particular circuit for my guitar but need a hex pickup. Where can I find one?

Bill Berardi
Milford, MA

Bill—You can get hex pickups from a Bartolini dealer. Write to Bartolini Pickups, P.O. Box 934, Livermore, CA 94550 and request a catalog and dealer list. They make a variety of hex pickups for guitar and quad pickups for bass. The guitar pickups include mini humbucker, large humbucker (which can be single or double for each string; in other words, there are two rows of six coils per string), and Strat type pickups.

D.I.Y.

I just received the January 1986 issue of EM. enjoy Thomas Henry's column, "Practical Circuitry" and support D.I.Y. (Do-It-Yourself) articles. Although a lot of equipment is cheaper to buy than build yourself (considering time), I greatly value understanding the equipment. I would like to see some construction articles on digital processing equipment, such as a digital delay and the hardware and software involved in digital tone sampling.

I have been reading **EM** and its predecessor (*Polyphony*) for many years; it has been the source of much of my knowledge on musical electronics and I have built some good equipment from its construction articles. Don't let **EM** become a magazine that just reviews what is available—show me how it works.

Paul Berry
Gustavus, AK

Paul—Your suggestions for articles are good. I hope at least one of our readers/authors can oblige. And don't worry about **EM** *becoming just another review-oriented mag; we remain committed to de-mystifying, not just publicizing, the latest developments in musical electronics.*

Error Log:

In the January 1986 "Released & Reviewed," the review of **Algebra Suicide** was incorrectly listed under the name of Michael Brook. Michael Brook's review did not appear but *is* in this issue.

Also, on page 28 of the February issue, under "Early Reflections" the sentence "Closely spaced early reflections indicate a large space" should read "Closely spaced early reflections indicate a *small* space." We apologize for any confusion caused by these glitches.

Operation Help

Operation Help is dedicated to helping musicians help each other. If you need technical assistance, a schematic for some old piece of gear, or just want to connect with people having similar interests, send your name, address, phone number (optional), and nature of your request to Operation Help, Electronic Musician Magazine, 2608 Ninth St., Berkeley, CA 94710. *There is no charge for this service, but we cannot guarantee that all requests will be published.*

Theremins: I have been playing an older instrument, but now it is fading rapidly. As not only play theremin myself but work with two other theremin players, I could really use schematics for a new instrument or new design. Eric Ross, 259 Oak St., Binghamton, NY 13905. Tel. 607/722-1457.

Composition competitions: I would like any and all information concerning composition competitions specifically for electronic composers. Jerry Gerber, 874 34th Avenue, San Francisco, CA 94121. Tel. 415/387-4605.

ARP 2500 schematics needed: If anyone out there has or knows where to find schematic documentation on any and all ARP 2500 synthesizer modules, please contact Larry Oppenheimer, Toys in the Attic, P.O. Box 590145, San Francisco, CA 94159-0145, or call 415/751-5686. will pay for duplication if necessary. **EM**

Coming Attractions

Read these informative features in future issues of

Electronic Musician!

MAY 1986

- Programming MIDI parameters, philosophy of programming, and several other programming tips for electronic musicians.
- Music with the IBM PC —you can play more than the Blues with this versatile computer.

JUNE 1986

- ***Electronic Musician*** takes a look at using video from a musician's perspective.
- An in-depth feature on the only computers with a built-in MIDI port—the Atari 520ST and 1040ST.

JULY 1986

- Electronic percussion —a special issue for drummers and other electronic musicians focusing on using and integrating electronic percussion in your music.

Suggestion Box

Here's your chance to make suggestions to the industry. Send your complaints, compliments, and ideas to: Suggestion Box, Electronic Musician, 2608 Ninth St., Berkeley, CA 94710. *We also welcome suggestions from manufacturers to users of individual pieces of equipment.*

This month's suggestion box is devoted mainly to a paper presented by Sight & Sound Software in January 1985. It raised some interesting points then; we've excerpted those that were most applicable. We also have a very sensible suggestion on patch protocol from synthesist Mark Kovach.

Opinion: Thoughts on the Subject of MIDI

We are on the verge of seeing computer-based MIDI (Musical Instrument Digital Interface) music systems become big business. If MIDI is to become highly successful, however, hardware and software standards must evolve and each company must have a well thought out marketing strategy.

Ideally, making music should be as easy and enjoyable as playing any video game. The new technology will make this possible; unless hardware and software standards are developed, however, the full potential will not be realized. The music industry must avoid duplicating the well-known situation between the VHS and Beta systems of video recording that held back VCR growth for many years. Therefore, MIDI software must be workable with all MIDI instruments, regardless of brand.

We as computer software specialists have a slightly different perspective on MIDI than a hardware, keyboard, or sequencer builder would have. MIDI remains the same, but our priorities are shifted. The following includes how we feel a number of MIDI topics should be approached.

CHANNELS

Software will be more successful if the MIDI channel selection mechanism is straight forward. Arcane rituals of arbitrary key sequences should be avoided.

We are also interested in multi-timbral control of individual synthesizers. We would like to see more machines capable of Mono mode; even more, we would especially like to see machines that can assign a block of voices to a channel, with one patch, and another block to another channel, and so forth.

PITCH WHEEL

The current MIDI implementation of pitch bend and mod wheel information is not ideal from the point of view of computer control. Sending or receiving a long stream of real time changes, in order to manifest a continuous, smooth transition, is expensive in terms of computer memory, CPU time, and bandwidth on the MIDI bus. First on our wish list is an alternate control that specifies beginning and end points and the number of MIDI clocks intervening. Likewise, we would like to see a discretionary standard, mapping pitch change in cents to degrees of MIDI pitch bend bias. This would allow for consistent pitch bend changes between instruments.

PATCH STANDARDS

MIDI allows us to change instrument definitions for a synthesizer while the music is actually playing, but the instrument definitions for the various synthesizers available are far from standard. Patch #4 on a DX7 is nothing like patch #4 on a Juno 106. Even the numbering systems are different.

We feel it's necessary for an arranger to specify patch #4 and have a reasonable idea of what it will sound like on any synthesizer. This would allow an arrangement to be transported from keyboard to keyboard. Our research team has wasted many hours redefining the patches for our demo songs to conform to the instruments available for a particular demonstration. Patch standards would allow software suppliers to provide arrangements that would sound closer to the original recordings when played back. This would be valuable, also, to people doing synthesizer transcriptions of classical works where the score calls for specific instruments.

We intend to develop a master list of about 24 standard instrument definitions that would probably be present on any of the newer keyboards. For any keyboard with which we work, we would come up with another list of patches on that keyboard that are equivalent to the patches on the master list. The computer would have a chart for the instruments in its setup so whenever a particular patch would be called for, it would translate that to the equivalent patch for the specific keyboard. For instance, if we decide #4 means *viola*, and we're working with an SCI 6-Trak, the computer might actually change it to patch #12, which sounds something like a viola. Naturally, the viola patch on some other keyboard may sound quite different, but at least it wouldn't sound like a police whistle.

If a musician changed instruments, the computer would have to be told about it so it could look up the definitions for the new machines. If the new instrument was one we hadn't gotten around to yet, we would provide a configuration program so that the user could make an equivalent list.

Accordingly, we would like to come up with a list of those sounds that would be the most useful. Probably, the shorter the list the better, for the following reasons:

✓ The likelihood that any synthesizer would carry an equivalent instrument definition would be greater.

✓ The table would take up less memory space in the computer.

✓ It will be easier for novice arrangers to get a handle on a shorter list.

✓ Expert arrangers won't be satisfied with the standard patches, no matter how many of them there are.

We would like to be able to assign the number of voices to each of the channels via software—possibly through MIDI System Exclusive commands. For every channel having more than one voice assigned to it, the sound source should independently handle how each incoming tone is assigned to a voice.

CONCLUSION

We, along with other software manufacturers, should convince the hardware producers of the need for standards, and develop *software standards* to eliminate confusion in the marketplace. This will take cooperation and open lines of communication. Before RCA and Columbia could compete for record sales, the standards for creating records had to be established and followed. Whether it's records, computer programs, instruments, or other type of consumer goods, no one company ever has it all. *Sight & Sound Research Team, New Berlin, WI.*

Patch Protocol

While working on organizing some 1600-plus voices for the Yamaha series synthesizers, I discovered that many voices have similar names, but are different patches, and that many with dissimilar names are basically the same voice, either slightly reworked or simply renamed. This can cause much grief, and consume considerable time. Therefore, since most of America now has everyone else's "original" voices, let's try to follow some basic guidelines to help each other save some time. The suggestions are:

—page 15

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On the Circuit

BY JAMES FINCH

Send information and news on active electronic musicians to James Finch, P.O. Box 176, Salamanca, NY 14779.

Professional synthesist **Suzanne Ciani,** whose work graces commercials by Coca-Cola, General Motors, Mobil Oil, People Magazine, and Columbia Pictures, has moved from Broadway to 30 E. 23rd in New York City, New York 10010. Ciani's first LP, *Seven Waves*, was first released in Japan in 1982 and then domestically on WEA's "avant" label, Finnadar. It is still selling quite well, especially in the "New Age" markets, despite the fact Suzanne does not consider herself a composer in that genre. Her music is quite varied, from the sublime "floating" style to powerful orchestral washes. Her new album, *Velocity of Love*, will be released very soon, but probably not on Finnadar.

Steve Roach has done a number of live, sold-out concerts in the West recently and has scored a Japanese video called *Tsukino Fune* (In Silence) by one of Japan's premier television producers, **Tadayoshi Arai.** The video is scheduled for release around spring or summer of 1986. Tadayoshi has produced videos for Fumio and others.

One cannot discuss "Space" or "New Age" music without some mention of **Klaus Schulze,** who has been recording cosmic sounds since the late '60s. Once a member of Tangerine Dream and allegedly thrown out of same for "being too weird" (Tangerine Dream used to be an unsuccessful heavy metal band), Klaus Schulze went on to fame in the '70s as a premier solo artist producing dreamy, sequencer-laden music that caught Europe by storm, leading to the success of many offshoots, Tangerine Dream among them. Late in 1979, Schulze left the progressive rock label, Brain (Metronome) to start his own label, Innovative Communication a.k.a. "IC." After making a success with this label for himself and several new stars, such as Robert Schroeder and Baffo Banfi, Schulze sold IC and went on in 1982 to form Inteam. Due to the economic recessions and other factors, however, his new venture did not fare as well and he finally re-signed with Brain/Metronome, releasing an EP in 1984 called *Macksy*. His new album, *Inter Face,* which fuses techno with his old "space" style, is enjoying some airplay in the U.S., but has to compete with many of his "musical descendents." Nonetheless, it is interesting that after nearly 20 years, the German King of Space still reigns supreme with his fans.

One anticipates what the new **Emerson, Lake & Powell** LP will sound like, but music promoters are anxious to find out whether it will be an item for the many new progressive rock bands to cling to as far as getting their own musical feet in the door with contemporary U.S. radio and record markets. New bands, such as **Tokyo** from Texas, **Mental Picture** from Wisconsin, **Drama** from California, **Kit & Coco** from Virginia and many others are gradually breaking through the New Age marketing blitz to reach not only to the Baby Boomers who supported their sound in the "hot '70s" but younger audiences as well.

Progressive rock, which fuses rock music with many other idioms (including classical and avant-garde) has returned with a more electronic sound, but with the same freshness as the European masters of the late '60s and '70s. Electronic music in Europe no longer moves as fast or as furious as it does now in America, according to famed electronic music producer and Klaus Schulze publisher Klaus D. Mueller of West Germany. According to Mueller, "the market for electronic music in Europe isn't as big as Americans think. Besides this, by itself 'electronic' isn't a novelty anymore. The music, the song, has to have normal parameters, a 'hook-line,' must be danceable, and so on—otherwise a record company isn't much interested, because they can sell only 1,500 to 2,000 copies." Despite the increased number of electronic music outlets, many musicians have indicated an increased difficulty in getting signed without "having a connection" at one or more of these labels. Recording artist Yanni says "demos don't work—you have to *be there* physically with the record producer and let them hear your music." Considering the competition among importers, who also put out their own recordings (Jem, Important, and others), artists continuously complain about having to push all the harder to get heard. But that's the nature of the music game, isn't it? All in all, it seems more likely you will have better luck at home than in Europe, according to many of the experts over there.

While the interest in progressive rock has cooled somewhat in Europe and Japan, the Soviet Union and the United States continue to be fertile grounds for a new wave of progressive rock bands. The Soviets, having entered the Digital Age in synthesizers now and heavily influenced by their beloved jazz and classical idioms, are trying to influence the young with "a cultural alternative to the bourgeoise American pop." Stravinsky with a beat? Well, thanks to the Sov label Melodia, many progressive rock bands in the U.S.S.R. get their chance to reach the vast youth of the largest country on Earth.

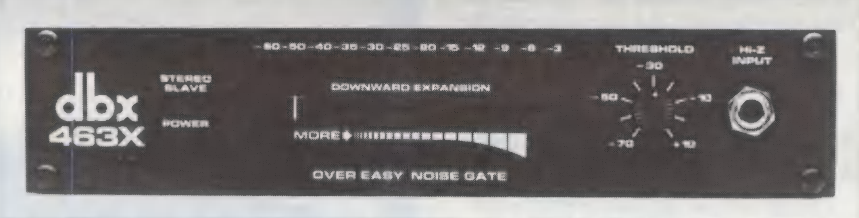
Recording artist **Ken Stover,** who has just released his debut solo album, *Closer Than Home* (CAI Records, $8.98, 12021 Wilshire Blvd. #505, Los Angeles, CA 90025) has been performing professionally for over 15 years. He's currently touring with CBS jazz artist **Rodney Franklin.** Stover has recorded and played with the Doobie Brothers, Quicksilver Messenger Service, Steven Halpern, and Paul Horn among others. Having experimented with the effects of light and sound on human awareness, Ken Stover continues to compose music for multi-media projects such as the Sensonics Dome, an event which utilized huge video-projected images and surround-sound, as well as for video and theater. *Closer Than Home* was produced by Kit Thomas, who has produced music videos for such notables as John Denver, Diana Ross, Rick James, John Waite, Ronnie Milsap, Alabama, Kim Carnes, and others.

Jerry Gerber of Polyphony Productions (not affiliated with Polyphony Publishing Company), works extensively with the Yamaha DX7 and has used his talents in the *Twilight Zone* series for CBS as synthesizer programmer for Merl Saunders. Gerber has also contributed music to the award-winning films *Origin* and *Water Wars—The Battle of Mono Lake.* Gerber works with McHugh Music Publishing as a composer, and has also worked with famed folk singer Holly Near.

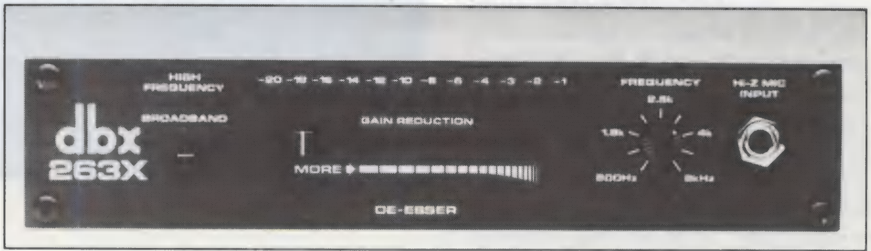
Steve Kellerman of WCVT 89.7 FM radio (Towson State University, Media Center, Towson, MD 21204), who does a weekly show called *The Cosmic Music Experience* every Saturday night from 8 p.m. to 11 p.m. is compiling a series of artist interviews for syndication and consultation

—page 15

***James Finch** founded the IEMA (International Electronic Music Association) in 1979 to unite electronic musicians and listeners, and generally promote the art of electronic music. He currently runs IKON Records and is "an avowed couch potato, complete with headphones and VCR."*


dbx
463X
STEREO SLAVE
POWER
-60 -50 -40 -35 -30 -25 -20 -15 -12 -9 -6 -3
DOWNWARD EXPANSION
MORE
OVER EASY NOISE GATE
THRESHOLD
-30
-50
-10
-70
+10
HI-Z INPUT

(Above) dbx Model 463X Noise Gate Expander; (below) Model 263X De-esser


dbx
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HIGH FREQUENCY
BROADBAND
-20 -18 -16 -14 -12 -10 -8 -6 -4 -3 -2 -1
GAIN REDUCTION
MORE
DE-ESSER
FREQUENCY
2.5k
1.8k
4k
800Hz
8kHz
HI-Z MIC INPUT

COMPONENTS

The ATT, a DIP-packaged T-attenuator switch adjustable from 1 to 31 dB in increments of 1 dB, sets attenuation levels in a matched-impedance transmission line. Nominal impedances of 50, 75, 150, 300, and 600 Ohms are available, as are optional models featuring 0.5 dB, 8 dB, and 16 dB per step attenuation. Alco Electronic Products, 1551 Osgood St., North Andover, MA 01845. Tel. 617/685-4371.

ELECTRONIC GUITAR

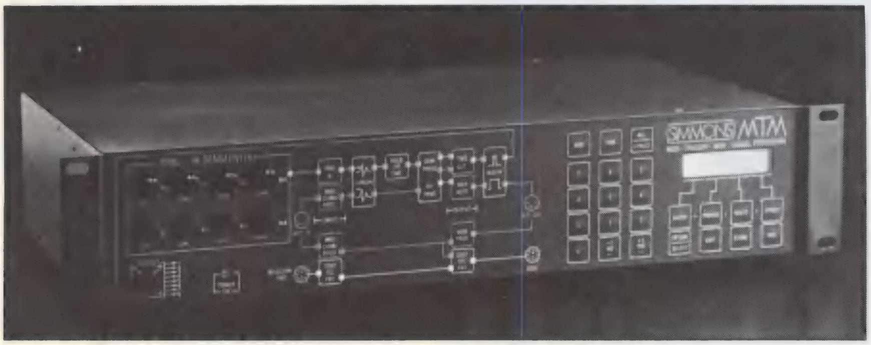
A MIDI Control System for guitarists consists of the MIU8 Interface Unit (1 in/8 out MIDI thru box) and IFC60 Intelligent Foot Controller. The latter is a remote control with a large three-digit LED display suitable for selecting different programs on MIDI-controlled signal processors or controlling up to eight MIDI devices from one main controller. The EPP400 Effects Patching Programmer is a MIDI controlled electronic patch bay. It features five effects loops (three in stereo) whose status (on/off) and sequence are under MIDI program change control. One hundred twenty-eight patches may be selected, and the EPP400 can be assigned to any of the 16 MIDI channels. This is just the thing for guitarists who want a MIDI controlled switching system yet also want to retain their existing effects. Finally, the DUE400 multi-effects system features a compressor, fuzz, digital delay, and flanger/chorus. Patch selection is under MIDI program change control. Ibanez, P.O. Box 886, Bensalem, PA 19020.

EPP 400
Ibanez
EFFECTS PATCHING PROGRAMMER EPP400
IFC60
Ibanez

Ibanez Effects Patching Programmer

PERCUSSION

The MIDI Trigger Module ($1,195) converts eight channels of drum pads, acoustic drum, or tape signals so that they can trigger MIDI and non-MIDI electronic sound sources under full dynamic control. Features include 32 character LCD display; on-board echo, sequencing, and note layering effects; compatibility with the SDS5 and SDS7 as well as many other devices; and rack mount packaging. Simmons, 23917 Craftsman Road, Calabasas, CA 91302. Tel. 818/884-2653.


SIMMONS MTM

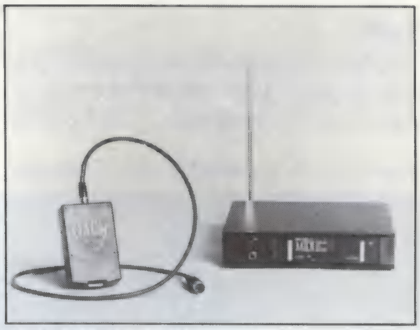
Simmons MIDI Trigger Module

SIGNAL PROCESSORS

The 263X de-esser and 463X single-channel noise gate ($149 each) feature LED indicators and interface to ¼-inch phone jack, unbalanced patch bays and systems. Both units come with all necessary hardware to mount one or two units side-by-side in a 19-inch rack. dbx, P.O. Box 100C, Newton, MA 02195.

SYNTHESIZERS AND MIDI

The Wireless Link transmits MIDI information in the VHF radio band for wireless MIDI setups. The setup consists of a MWL-1R MIDI Transmitter, three-foot MIDI connector cord, and MWL-1R MIDI Receiver; all MIDI parameters occurring over all 16 channels are transmitted via a VHF radio signal. Transmitter battery life is rated at approximately four hours. Nady Systems, 1145 65th St., Oakland, CA 94608. Tel. 415/652-2411.



Nady Wireless Link

The MIDI Cord Tester ($12.95) tests MIDI cables and presence of MIDI signals. No batteries or other accessories are required. CAE, 1150 E. Santa Inez, San Mateo, CA 94401. Tel. 415/348-2737.

The M1X ($295) and M1X+ ($375) MIDI mixers merge two MIDI signals into one composite output. In addition, M1X+

is equipped with front panel switches that allow assignment of any combination of the two inputs to the two sets of MIDI outputs provided, thus eliminating frequent cable plugging and unplugging in many setups. Harmony Systems, 4405 International Blvd., Suite B-113, Norcross, GA 30093. Tel. 404/923-2121.

Mirage samplers prior to serial number 14731 can be upgraded to current specs (improved bandwidth and signal-to-noise ratio) with the Mirage Update Kit ($19.95, installation not included). The kit includes a new EPROM, operating system diskette (version 3.1), and assorted electronic components. It must be installed by an authorized Ensoniq Repair Station in order for the warranty to remain in effect. Ensoniq Corp., 263 Great Valley Parkway, Malvern, PA 19355. Tel. 215/647-3930.

The LX-4 Programmable MIDI Controller ($495) allows for patch, volume level, and octave settings of four synthesizers or expanders from one central location. It also splits any master synth keyboard into three zones (with user-programmable split points) and overlay the sounds of the three external synthesizers or expanders on the zones. Ninety-nine setups can be stored in memory for instant recall. Voyce Music, P.O. Box 27862, San Diego, CA 92128. Tel. 619/549-0581.

Voyce LX-4 Programmable MIDI Controller

VOYCE
PROGRAMMABLE
LX4
MIDI CONTROLLER
MIDI CHANNELS

TELECOMMUNICATIONS

A Kurzweil 250 Users Group is now online with PAN, the international computer network for musicians. Owners may exchange sound files and technical information with each other and the manufacturer, who is actively seeking user feedback. Kurzweil Music Systems, 411 Waverly Oaks Road, Waltham, MA 02154.

VIDEO

The VSE-1 Video Sound Enhancer ($129.95) creates stereo from mono sources, provides bass/treble controls, includes DNR single-ended noise reduction to minimize hiss, and drives a pair of speakers (not included) with its 12.5 Watt per channel stereo amplifier. The CA215 ($129.95) is a medium-power, general-purpose audio amp designed to drive speakers from a TV or VCR audio source. Parasound, 680 Beach St., San Francisco, CA 94109. Tel. 415/673-4546.

COMPACT
disc
Emulator II

CD-ROM Disk Drive

OTHER NEWS

The CD-ROM Disk Drive works with the Emulator II sampling keyboard and stores the equivalent of hundreds of floppy disks of Emulator II sounds. Sounds can be rapidly downloaded from the read-only CD into the Emulator, where they may be used as is or modified within the machine and saved to floppy disks. Initial versions access the Emulator through an Apple Macintosh, but future versions will have a direct interface. Optical Media Services, P.O. Box 2107, Aptos, CA 95001. Tel. 408/662-1772.

The Telvac Tool Kit consists of more than 30 standard tools for servicing electronic and electrical equipment. This line is intended for students, hobbyists, and in-house service departments. Jensen Tools, 7815 S. 46th St., Phoenix, AZ 85044. Tel. 602/968-6241.

Telvac Tool Kit

The bi-annual Harvey Gaul contest for American composers, sponsored by the Pittsburgh New Music Ensemble, Inc., is one of the oldest continuing composition contests in the U.S. First prize is $1,500 and a premier by the Ensemble during its 1986-87 season. For further information write to: The Harvey Gaul Composition Contest, 6538 Darlington Road, Pittsburgh, PA 15222. Tel. 412/244-9996.

The AB-85 Sound Level Meter ($149.75) measures from 40 to 110 dB across six measuring ranges; an "A" weighting network simulates human ear response. Frequency range is quoted as 31.5 Hz to 8 kHz. 9V battery life is 150 hours in continuous operation. Abbeon Cal, 123-400 Gray Avenue, Santa Barbara, CA 93101.

All prices are suggested retail prices, as supplied by the manufacturers. All prices and specifications are subject to change without notice.

Industry Trends

BY STEVE SAGMAN

Among those who follow the home computer market, the Commodore-Amiga-versus-Atari-520ST is the popular current comparison. However, the machines are really very different. The Amiga brings to our homes the current state-of-the-art in personal computer technology, but at a price-point well above other home computers—approximately $1,800 for a starter system (see David Karr's article in this issue). On the other hand, the Atari ST series (standard 520ST and the new, 1 Megabyte 1040S) are high-performance computers but without some of the flash and, more importantly, with a lower price tag. The current rumor is that 520ST computers will be mass marketed at a fairly low price (systems consisting of computer, disk drive, and monitor are expected to be discounted to around $600 to $700) and the 1040ST, with its built-in disk drive, will be sold through specialty stores for around $1,200 (including monitor).

Commodore's Amiga and Atari's STs are often lumped together because of their producers' common histories and their similarities in hardware. Both companies were home computer pioneers, and their new machines employ the same speedy 68000 processing chip for spectacular color graphics and other advanced computer processing.

The products are similar in another way. In the good old days of consumer marketing, companies spent months and even years with careful, comprehensive marketing preparations and contingency plans for their new product introductions. Products had long life cycles and their makers had plenty of time to ready the next model. In today's lightning-fast high-tech business, marketing execs struggle to keep ahead of their competitors' advancements. They even struggle to keep abreast of their own products' rapid improvements. The computer market's time pressures and the waning health of both Atari and Commodore rushed the release of both machines. The result has been confusion about just who is supposed to buy the machines and for what purpose.

Over and over, we've seen that the key to the home computer market is *software availability.* Compounding the "rushed introduction problem" is that software producers have not rushed to complete programs for the machines. These companies need to know that there is a large enough installed-base of machines before they can justify spending thousands of man-hours developing software. While the Amiga and Atari STs were released with programming languages, few other application software programs have been available. By the time you read this, there should be 50,000 to 75,000 Amigas sold, and over 100,000 Atari STs (with the majority sold in Europe). With that kind of installed user base, MIDI software is beginning to appear, and at the January NAMM show we saw exciting new products for both computers from Hybrid Arts, Hippopotamus Software, Cherry Lane Technologies, Mimetics, and several others.

Even with these similarities, the two machines will probably appeal to different segments of the electronic musician market. Again, the key is pricing. The Atari is complete and inexpensive enough for a musician to consider dedicating it to music-making. For under $1,000, you get a top-notch computer with loads of memory, fast disk access time, and built-in MIDI ports. On the other hand, I doubt that any computer music enthusiast would be willing to leave an Amiga solely in the studio. With the additional cost (and additional capabilities) of the machine, you can be sure that buyers will spread their use of the machine to applications other than music.

What eventually happens in the marketplace will depend on how Commodore, Atari, and the software publishers who align themselves to one machine or another decide to promote their products to the music industry. Reportedly, Atari has been very helpful to music software authors, and we've even heard that Commodore is planning a rack mount version of the Amiga. That's the word so far; the future is anyone's guess.

***Steve Sagman** is a New York-based keyboard player, marketing consultant, and editor of* MIDI Marketer *(an industry newsletter covering the electronic musical instrument business). When he's not entangled in MIDI cables, he leads an acoustic jazz quartet.*

—from page 10, Suggestion Box

✓ Please, do not rename voices. The creator had reasons for giving it a particular name, no matter how irrelevant you may think it is.

✓ Don't change an algorithm or parameter and then submit the new voice to a bank, under a new name, unless your change is really radical enough to warrant renaming. Rather, put your initials in front or back of the original name, to show that it was someone else's voice with your custom modification.

✓ Always put your initials or identifying code on all voices that you create. I think it would be nice to see how far your creation has emigrated around the country—maybe even around the world.

✓ No more strings, bells, or brass please. Let's go for some really good bass and new imaginative sounds. Be creative... let's hear people praise your AZ#Blazfits.

Of course, this can only work if everyone cooperates, and no one becomes petty. We should all use as our example, the people at E-mu and all Emulator owners. I have yet to meet one of the aforementioned persons who wasn't eager to share some custom sounds with me.

Also, keep in mind the amount of variation that the music business has dealt us, and realize that if we help each other with the basic tasks necessitated by computers and MIDI, we will all have more time to do what we really want to do—make music. *Mark Kovach, the Music Deli, Flushing, New York.*

—from page 12, On the Circuit

called *The Music of the Spheres Interview Series.* Those interviewed include Ed Van Fleet of Synchestra fame, Michael Stearns, Steve Roach, and Chris Spheris among others. For more information, write to Steve Kellerman at the above address.

Malaysian Pale is their name, melodic synthesizer music is their game. Led by composer Manfred Saul, who has been a professional for over 20 years, the five-member group has been well received in electronic music-conscious New Jersey, especially on the popular WFMU (New York City) radio program Synthetic Pleasure. Other members are Steve Mecca, Terry Kennedy, Lily Lutgen, and Mike Lutgen. Contact Manfred at: 25 Kearny Ave., Whippany, NJ 07981.

According to **Paul Speer**'s manager **Kipp Kilpatrick**, the innovative music video *Natural States,* (see "Released & Reviewed" this issue) will be shown on VH-1 in 1986. The video features landscape images and powerful music. For more information, write Nova Music, P.O. Box 70127, Bellevue, WA 98007.

Released & Reviewed

BY ROBERT CARLBERG

David Lanz/Paul Speer, *Natural States* (cassette); ***Natural States*** (video). *Natural States* is, quite simply, some of the prettiest music you're likely to hear. Speer (a guitarist and synthesist) and Lanz (keyboardist and synthesist) together expand "New Age" or "ambient" music into tonal colors more familiar to jazz-rock fans—while still maintaining a basically minimalistic framework. The video is a series of Steadicam journeys over the Pacific coastline, through the Northwest rainforests, or up a snow-covered mountain, edited to the music by Jan Nickman. The scenery is beautiful, but there's something slightly unsettling about watching the glory of nature on TV. Audiocassette: $10.45 postpaid; videocassette: $32.45 postpaid from Miramar Productions, P.O. Box 70127, Bellevue WA 98007.

Joni Mitchell, *Dog Eat Dog* (Geffen 24074). The lyrics are just as cynical as *Wild Things Run Fast*, but Thomas Dolby's production brings some much-needed humor, big-ticket synthesizers and a few respites from her well-aimed venom. She's dressed for success.

Smith and Erickson, *Blue Skies* (cassette). A guided tour to self-hypnosis. The 19-minute title track presents Dr. K. Z. Smith, a stress-counselor, giving trance-inducing narration over the gently supportive synthesizer of Dave Erickson. The rest of the tape is backgrounds by Dave alone for further self-explorations. $10 from P.O. Box 10067, Berkeley CA 94709.

Michael Brook, *Hybrid*, (Editions EG 41). Michael Brook does for the guitar what Jon Hassell does for the trumpet. Even more than Phil Manzanera's "impossible guitar," Brook redefines the sound of a guitar, using studio tricks and exotic techniques. Of course, the assistance of Brian Eno and Daniel Lanois probably doesn't hurt.

STEWART COPELAND
THE RHYTHMATIST

Stewart Copeland, *The Rhythmatist* (A&M 395084-2). It's easy (and somewhat fashionable) to casually dismiss The Police for being too popular, but the truth is each member is quite talented and multi-dimensional. This disk is half African pop (resembling King Sunny Ade or Afrika Bambaataa) and half Police-like Fairlight and drums constructions, and it's not always possible to tell the halves apart. This is an authentic fusion of Western-influenced African music and African-influenced Western music.

SKYWALK
Silent Witness

Skywalk, *Silent Witness* (Zebra 5004). Skywalk is a keyboard-led jazz group out of Vancouver B.C., using restrained soloing within highly-composed formats to show where Jeff Lorber Fusion, Hiroshima and Spyro Gyra could have gone if they'd had more taste.

Tangerine Dream, *Dream Sequence* (Virgin CDTD 1). Virgin has been very diligent about re-releasing the T.D. catalog in the CD format. For many of us however, the $200 investment to change over is a bit daunting. Here's a compromise—2¼ hours of the best of the Dream's Virgin releases on two CDs, digitally remastered with a concise and unusually frank history of the band. The importance of the band and the fecundity of their ten years with Virgin (1973-83) makes this a superlative collection—and you might just save $160.

Larry Kolota, *Second Order Effects* (cassette). Four tunes (half of a C-60) in the style of Larry Fast, recorded at home on a Portastudio. Kolota's sophisticated harmonic development and flair for electronic orchestration indicate he's definitely pushing the limits of his equipment rather than vice versa. Where are the $10,000 "Artist Development" grants when you need one? Oh well—if 2,000 of you send $5 to 13715 Cordary Ave #120, Hawthorne CA 90250, you'll be contributing to a worthy cause (and get a free tape in the deal).

Tom Gulch, *Somnility* (cassette). On loan from the Nightcrawlers, Tom's first solo consists of gentle keyboard meanderings over slowly shifting background chords. Different synthesizer voicings and textures ranging from Michael Garrison to early Tangerine Dream keep the rather simple concept from growing stale—almost. $4 postpaid from 1493 Greenwood Avenue, Camden NJ 08103.

Five Star, *Luxury of Life* (RCA 8052). Five Star may be something of a manufactured phenomenon along the lines of the Jackson 5 or Musical Youth, since the two brothers and three sisters didn't write any of the songs or play any instruments. Yet there's no denying the accomplishment of their harmonizing in the arrangements provided by some of England's top studio musicians and producers. It's elegant.

The Bobs, *The Bobs* (Kaleidoscope 18). Imagine DEVO caught in a red-neck bar in Iowa. Ten seconds into the first number, Tiny the bartender shuts off the power to the stage. "You boys know any real music?" he inquires, leaning over them. Luckily, they've been studying the Bobs' record of New Wave barbershop. Nobody dusts off the dance floor, but they live to see another soggy morning on the strength of that incredible stroke of luck.

Ashwin Batish, *Bombay Boogie/India Beat* (single). Just a year ago, Batish writes, he was content to study traditional North Indian music, practicing his sitar and tablas. Then, one day he wandered into a music store in his native Santa Cruz, California and fell in love with a Yamaha

---

***Robert Carlberg** is the national service manager for Audio Environments Inc., a nationwide supplier of original-artist music for restaurants and fashion stores. His hobbies are electronics and music, and particularly electronic music. He was co-founder of SYNEX, a newsletter for electronic musicians published during the late '70s.*

THE MIX BOOKSHELF

Welcome to the **MIX Bookshelf** where you'll find the most comprehensive selection of professional resources available anywhere for the recording, audio, video, music, and broadcast industries. In addition to publishing quality materials under our own imprint, we have arranged to distribute books, tape courses, and professional materials for more than 50 other leading industry publishers as a service to our readers.

Now, from one source, up-to-date trade resources are easy to find and order over the phone or through the mail. Send for our free catalog listing hundreds of current titles.

1010) PRACTICAL TECHNIQUES FOR THE RECORDING ENGINEER, Sherman Keene An excellent, down to earth instructional guide for the engineering/producing arts. Divided into three categories (basic, intermediate and advanced), the text is accessible and extremely useful to students at different levels of competency. Also available as a correspondence course and for school curriculums with Teacher's Manual, workbooks, and exams.
221 pp. (H) $29.75

1200) CRITICAL LISTENING COURSE, F. Alton Everest This invaluable course specifically addresses the important nuances of the audio world. The 106-page training manual with ten pre-recorded lessons on cassette tapes lead you from basic to advanced listening techniques in increasing progression. Topics include estimating frequency, frequency band limitations, sound level changes, components of sound quality, frequency response irregularities, various types of distortion, reverberation effects on speech and music, signal vs. noise, and voice colorations. $129.95

1300) BUILDING A RECORDING STUDIO, Jeff Cooper, M. Arch., S.M., S.B., B.S.A.D. A step by step guide to recording studio construction for small or large budgets. Thorough coverage of the principles of acoustics, how acoustics affect recording, soundproofing a room, plus chapters on the studio, the control room, and a glossary of the 100 most misunderstood terms in acoustics.
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DX9 and Emu Drumulator. The rest, as they say, is history—and though fusions between rock and Indian music have flowered before (Ananda Shankar, Shakti, Saddhu Brand, even George Harrison's *Wonderwall Music*), never has more enthusiasm and pure joy poured out. $2.95 from Batish Records, 1310 Mission Street, Santa Cruz CA 95060.

Io
IAN TESCEE

Ian Tescee, *Io* (E-N Records 2010). There's quite a lot of territory between electronic jazz-rock (such as Group 87) and electronic meditation music (such as Robert Rich). Somewhere in between is Tescee—contemplative, yet he includes digital drums. Unfrantic, yet he writes real tunes with serious development, fully orchestrated. In short, Tescee's a consolidator, totally original yet mindful of Jean Michel Jarre, Synergy and Michael Hoenig. A beautifully recorded and packaged debut. $10.75 postpaid from Startsong, 3218 E. LaSalle, Colorado Springs CO 80909.

Allan Holdsworth, *Metal Fatigue* (Enigma 72002). Progressive rock's pre-eminent guitarist, having graced U.K. Bruford, Soft Machine, Tempest, Gong, and Tony Williams' Lifetime, certainly knows his way around six strings. Fans of the above bands will find much to like.

Meadowlark Sampler 1985 (Meadowlark 7006). Meadowlark is the new all-instrumental arm of The Sparrow Corporation, but the only indications that it springs from a Christian publisher are a few small dedications to God. One can hardly argue with their corporate philosophy, which is to give the best possible showcase to some of the tremendous instrumental talent residing behind the "Christian music" wall. It's sort of a New Age/Windham Hill-ish approach, except the productions are bigger and generally more uptempo. Premium quality vinyl (or cassettes), tastefully understated and coordinated covers, and a $9 list price have attracted the interest of some outside artists too. We'll look more closely at the individual releases in the reviews that follow.

Richard Souther, *Heirborne* (Meadowlark 7004). Like Tescee, Souther finds quite a bit of room between jazz and New Age. Using a full palette of over 20 synthesizers, Souther constructs gentle but fully realized numbers of great beauty and sophistication. Lest you think he's somehow otherworldly, he uses a lot of electronic percussion and rockin' basslines.

Douglas Trowbridge, *Songs Unspoken* (Meadowlark 7007). Douglas Trowbridge is in fact Richard Souther (full name Richard Douglas Trowbridge Souther). He records under his "other name" for piano solos to avoid confusing the record buying public. He needn't worry—every bit of the wit and skill of *Heirborne* comes through in his piano too, and fans of either record should delight in the other.

Justo Almario, *Forever Friends* (Meadowlark 7003). Playing saxes, flute and Lyricon, Coumbian-born Almario is joined by seven other musicians in a solidly-jazz setting. The styles range from slow Spyro Gyra to Paul Winter, with enough surprises to keep it fresh.

NO SHADOW OF TURNING

Jeff Johnson, Sandy Simpson, Dieter Zander & Kathy McClatchy, *No Shadow of Turning* (Meadowlark 7005). They play synthesizers, guitar, piano and harp, respectively, but they don't all play on every cut. Mostly one of them will solo with the accompaniment of yet-another musician, playing anything from tablas to seashell windchimes. The diversity complements the airy nature of the pieces.

John Michael Talbot, *The Quiet,* (Meadowlark 7001). Talbot is a Franciscan brother who lives in an Arkansas commune, but he also was the founder of the '60s rock group Mason Proffit. Here he plays acoustic guitar, and if you can imagine Will Ackerman with oboe, lute and cello, you'll be close.

Karl-Birgir Blomdahl, *Aniara* (Caprice 22016). *Aniara* is the landmark "Space Opera" by Sweden's leading avant-garde composer (1916-1968). It is perhaps best known here for the orchestral suite which filled out the non-official soundtrack album to *2001: A Space Odyssey*. Heard in its full 101-minute setting, it is a sprawling, kaleidoscopic cataclysm of the musical events of 1959, the year of its birth. Snippets of jazz, modern classical, Schoenbergian "Sprechgesang" (speech-song) and, relevant to our discussion, large chunks of *musique concrete* propel it along. It is by no means light entertainment, but contains within itself an entire universe in which one might live for months.

Kim Katzer & Bill Martin, *Nutcracker* (LP). There are two schools of thought on classical synthesis—the neo-traditionalists like Carlos, and Tomita's "Anything Goes" school. Katzer and Martin land squarely in Tomita's camp with this light-hearted dissection of a once-great ballet. $8 postpaid from 4315 Pacific Avenue, Tacoma WA 98408.

Nightcrawlers, *Spacewalk* (Atmosphere 200). Any synthesizer trio is bound to invite comparisons to the goundbreaking Tangerine Dream, but the Brothers Gulch plus Dave Lunt positively demand it by using similar voicings and structures. If T.D. had never existed this would be pretty amazing stuff, and fans of *Phaedra* or *Rubycon*-era Dream will think it still is. $8 postpaid from 1493 Greenwood Avenue, Camden NJ 08103.

Magic Mose & His Royal Rockers, *I'm Dreaming of a Noir Xmas/Have Yourselves a Groovy Little Solstice* (Arf Arf Records JJ 002; single). Novelty Christmas records probably don't do much business in the middle of the summer, but next December you'll be glad you read this. Remember Bill Murray's tacky lounge singer? So apparently does Magic Mose. Hey, I'm not making this up. P.O. Box 94, East Dennis MA 02541.

David Lanz/Michael Jones, *Winter Solstice* (Narada 1008). And as long as we're in the season, we'll wrap up the way we opened—with David Lanz. These are solo piano improvisations on familiar Christmas carols—just the thing to warm your eggnog by the fire. Peace on earth. EM

We asked for an article on guitar synthesis—and got back one of the most lucid, complete, and musically relevant treatments we've ever seen on the subject.

Guitar Synthesis: What You Need to Know

BY JIM WRIGHT

Nineteen Eighty-Six will be the year of the guitar synthesizer. For over a decade, players have been looking for an electronic instrument that will perform well, sound good, provide the versatility they need, and hopefully not bankrupt them in the process. Finally, several manufacturers are about to introduce truly functional guitar synthesizers, using new technology, hard-won experience and the nearly universal MIDI standard. Instruments like these should give guitarists the same degree of freedom and access to MIDI resources that keyboard players have enjoyed all along. They'll also be a lot of fun to play.

But will you be ready for them? Can you properly evaluate the different claims and features of the different products? And will you be able to put together a complete *system*—guitar controller, synthesizer, and accessories—that truly fulfills your needs?

The purpose of this article is to be a "Survival Guide" for guitarists exploring new regions of the hi-tech jungle. We'll cover the different technologies used with guitar controllers, and their particular strengths and drawbacks. Since virtually all of the new products use MIDI, this will be covered too, with a focus on the special demands of guitar playing. Finally, we'll discuss which synthesizer features are important for guitarists and how to put a typical system together.

***Jim Wright**, whose seminal* Polyphony *article "What MIDI Means to Musicians" was the Rosetta stone for many budding MIDI fanatics, learned MIDI on-the-job by working for Unicord on products such as the Polysix, Mono/Poly, and Poly-800. While at Octave Plateau, he fulfilled a 15-year fantasy by masterminding the design of "Sequencer Plus." Jim is a trained musician as well as an engineer and writer.*

If you come across an unfamiliar word or concept, several sidebars describe such topics as MIDI and the latest information available on specific products. A glossary of terms, and references for further reading, are given at the end of the article.

PART 1: BASICS

What is a Guitar Controller?

A guitar *controller* is what you play. This can look like a traditional guitar, or something totally space-age. The *synthesizer* is the part that actually makes the sound (aside from the normal string sound). Before MIDI, most guitar controllers contained the synthesizer, so the distinction didn't matter. Now that MIDI has taken hold, most guitar controllers are just that—controllers—so you'll need to buy the synth (sound-generating) part separately. This modular type of system is really an advantage, since it gives you a choice of synthesizers (therefore a choice of sounds) and allows for upgrades.

In many ways, guitars may make better synth controllers than keyboards since with six strings, you have highly *independent* control of up to six simultaneous notes. Each note can have different finger vibrato, different bending, or different articulation altogether. Very few keyboards provide this kind of subtlety. Each string can have its own synth sound, or you can program strings in groups (say, two strings for bass and four for chords/lead). Where strings have overlapping pitch ranges, you'll be able to choose between two (or even three) timbres for a given pitch. And, since different strings can potentially send individual data over different MIDI channels, they can activate different devices tuned to those channels: synths, samplers, drum machines and even lighting controllers (we'll describe how this works in a bit). Keyboards just can't provide the same kind of flexibility.

Guitar controllers can provide new means of articulation. Some units have pressure plates, neck bend sensors, special velocity and pressure sensing keys, knobs for controlling synth volume or other parameters remotely, and so on. At least one product has a display and *program stepper* built in; the latter stores many different *groups* of synth sounds, playing modes, tunings, and other parameters for easy live access of these setups at the push of a button (or maybe a few buttons).

All controllers are not created equal, and many factors influence how much a guitar synth system can actually do, as we'll discuss later. Nevertheless, the potential is mind-boggling.

GR-700 GUITAR SYNTHESIZER

Roland GR-700 Controller (above) and guitar synthesizer (right)

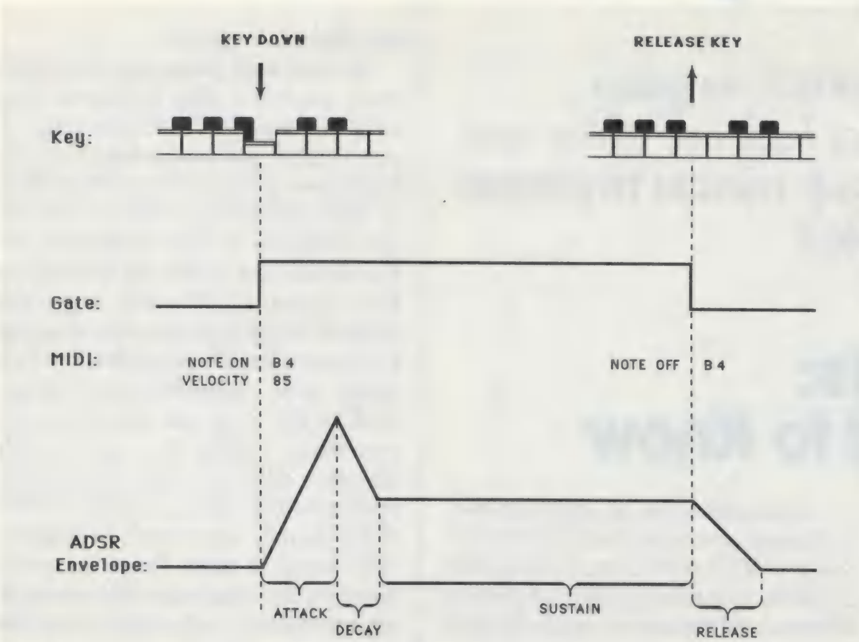

Fig. 1

The technology involved in making a guitar controller is equally mind-boggling. Any musically useful controller has to figure out the pitch and dynamics of a note, decide when notes start and end, track string bends and other guitar-related playing techniques, cope with chords, and do all of this so quickly that there are no audible glitches or delays. In short, a guitar controller must provide the same subtlety of response as a conventional guitar to produce the same caliber of music.

Some problems (such as pitch tracking) are handled differently by different controllers. Other problems, such as deciding when notes start and end, are common to almost all controllers.

The Note ON/OFF Problem

The basic difficulty with deciding where a note starts and ends is that guitars aren't keyboards. MIDI—and synths in general—have keys that go down when notes begin, and up when they end. Synth envelopes respond to the "gates" produced by this key motion (**Fig. 1**).

With MIDI, the envelope (note) begins when it receives a NOTE ON message (such as that generated by pressing down a key), and sustains until it receives the NOTE OFF message. It then goes into the Release stage.

But guitar notes don't always end so neatly; they often fade out over a period of time to nothing. How does the synth know when the envelope's Sustain stage ends and Release part begins?

Most guitar controllers have a threshold setting for producing NOTE OFFs. When the string amplitude goes below that level, a NOTE OFF message goes to the synth even if you're still fretting the string (**Fig. 2**). The range between the loudest note you can pick and the NOTE OFF threshold determines available dynamic range, which on some controllers is pretty limited. Other controllers (especially fret-wired ones) may have fairly wide dynamic ranges, and even some special playing modes where notes aren't turned off until you stop fretting the string, even if you hold it for an hour (talk about infinite sustain!!).

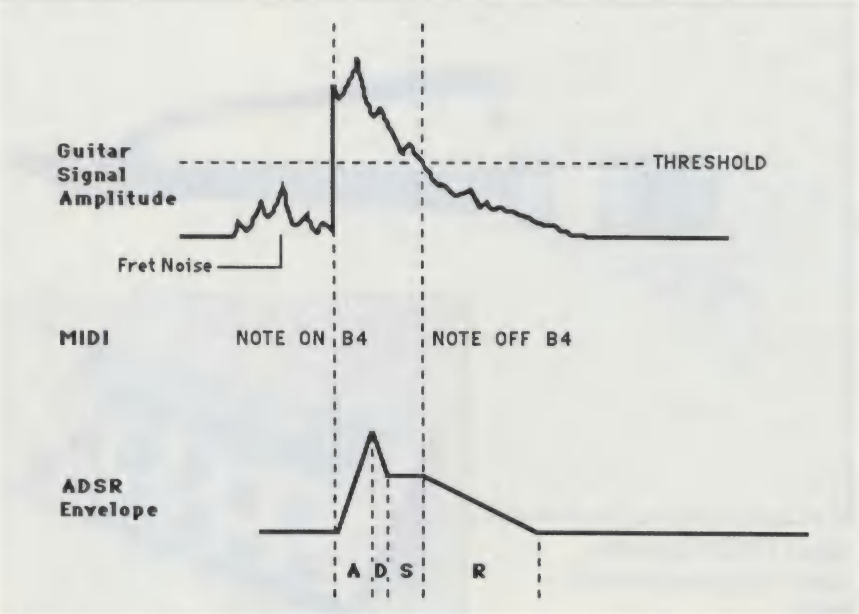

Fig. 2

Part 2: Guitar Controller Technologies

Pitch to Voltage (MIDI)

Pitch-to-Voltage (P/V) is for now the most common guitar controller technology. It measures the actual string vibrations to derive the pitch, amplitude (for determining dynamics), and so forth. This approach has gone through a lot of refinement, but it still fights some fundamental problems of physics.

A plucked string typically produces a sharp burst of noise and some harmonics at first, and then settles down to a pitch (**Fig. 3**). If the P/V circuitry tries to follow the noise, it may produce *glitches* (swooping pitches) until it can lock on to a pitch. But if it waits for the string to settle down, there will be a very audible delay. The best current P/V units are virtually glitch-free, and relatively fast, but even these must wait for one or more cycles before they can determine the note's pitch. Delays are particularly noticeable on bass notes since each cycle of a standard low E takes about 12 milliseconds. If the P/V requires two cycles for detection, that's 25 milliseconds of delay.

Despite the delays, P/V units are fine for controlling orchestral string sounds and other sounds with slow attacks. They're also well-suited to programming MIDI sequencers, since sequencers often auto-correct your playing or can shift a MIDI track with respect to time to "tune out" delays. For percussive sounds, though, you need to learn to play a fraction of a second ahead.

P/V controllers are more sensitive than other controllers to leakage between strings; a hex pickup is mandatory, and pickup quality and adjustment is critical. Since P/V converters require a fairly clean signal, you may have problems with two-

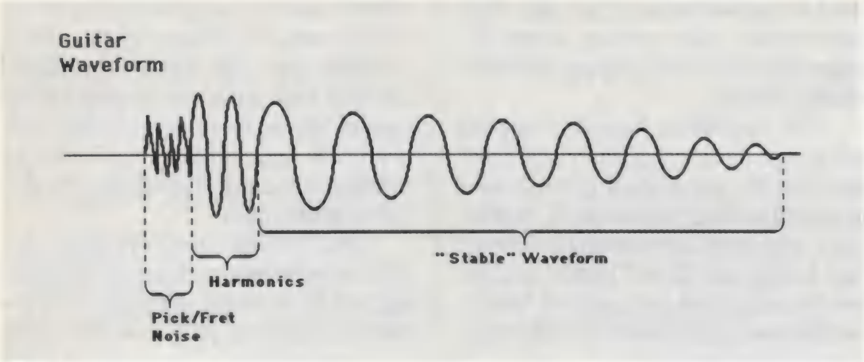

Fig. 3

handed "touch" playing techniques, and will have to probably play fairly evenly, thus limiting the dynamics of your playing. Be aware of these limitations if you want to get the most out of a P/V controller.

P/V units also have advantages. Since they track string pitch directly, they can theoretically provide "perfect" pitch bend matching. In other words, bending a string will change the pitch of the "acoustic" string tone and the synth tone identically. In practice, this may not work out if the controller and MIDI synths use different MIDI values for some or all amounts of pitch bend; nevertheless, P/V controllers generally do the job best if you want to use string and synth tones simultaneously.

P/V units are also suitable for retrofitting many existing guitars, which spares you from having to buy another controller. However, problems with pickup mounting and adjustment can make retrofits difficult; and guitars not designed with guitar synthesis in mind may not perform well (Roland's "synth-ready" G-707 uses a special reinforcing bar to stiffen the neck and improve tracking). In my opinion, though, the biggest problem with retrofits is that there's no easy way to put additional switches and controllers onto the guitar, which are needed for remote synth control and adding new expressive capabilities. A guitar built for synthesis can include lots of goodies.

FRET-WIRED (F/W) CONTROLLERS

Wiring frets was the first attempt to mate guitars and organs, but such products were never very widely accepted due to their inherent limitations. Modern versions use additional sensors and even built-in microcomputers to monitor the full repertory of string bends and dynamics. One key advantage of fret wiring is that you don't have to measure pitch directly! Instead, the strings and frets form a switch matrix, and the computer checks which switches are open or closed at least a thousand times a second. The actual string pitch is pretty much irrelevant (although strings shouldn't be tuned too low or dynamics sensors may not work properly).

F/W controllers, while more expensive than P/V controllers, avoid almost all of the P/V problems mentioned above. Theoretically, a good F/W controller can detect a new note at least ten times faster than a P/V unit. For this reason alone, F/W units will probably displace P/V units once mature products become generally available.

But F/W products are not perfect either. A string can rattle briefly against several frets, possibly producing false triggers and an unwanted trilling effect. Fret-

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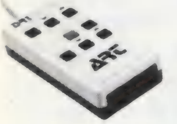

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ting a chord can create the same problem and cause several harmonies to alternate for an instant. This can happen with P/V products also, of course. In some cases, "ghost notes" (notes that aren't actually played) sound when certain combinations of notes are fretted.

The better controllers use software programs to analyze your playing and avoid the more unmusical effects. Some controllers offer a variety of playing modes to tailor the response to the type of music (lead, accompaniment etc.) you play. (Keyboard synths often provide several different Poly and Mono playing modes for similar reasons.)

F/W controllers have one very big advantage: since string pitch isn't measured directly, string bending can be used to control *anything,* not just pitch. Furthermore, some units can distinguish between "up" bends and "down" bends! So, "up" bends could bend pitch up and "down" bends bend pitch down; or, either type of bend could be programmed to add in vibrato, make the timbre brighter, control oscillator sync, FM depth, or anything else that your synth can do under MIDI control. Having that kind of control literally under your fingertips is bound to produce some truly expressive and dynamic synth music.

Note, however, that F/W units typically use sensors to measure string bending, and these sensors may respond differently in different places on the neck.

A Brief History of Guitar Synthesizers

Late-'60s: The Condor and Guitorgan were two of the earliest guitar-controlled electronic devices; both used the principle of wired frets. The Condor provided a range of different effects and had some primitive synthesis circuitry, while the Guitorgan was basically a Hammond organ connected to a guitar fretboard.

Mid-'70s: ARP's ill-fated Avatar, consisting of a special hex pickup combine with a monophonic P/V converter, "Odyssey" type synthesizer, and hex fuzz circuitry was the first "major" guitar synth. It never worked very well, and was probably a major factor in ARP's bankruptcy.

360 Systems and Gentle Electric both produced monophonic Pitch-to-Voltage (P/V) converters. These allowed guitarists, wind players and others to connect their instruments to Minimoogs and similar synths. Steve Morse (Dixie Dregs) used a 360 Systems SlaveDriver to great effect live. Gentle Electric is still selling their interface to experimental musicians and others, but the 360 Systems device is no longer available.

Ampeg introduced the Patch 2000 fret-wired guitars and basses in the mid- to late-'70s. These instruments could not handle string pitch bends, and provided a bend lever instead.

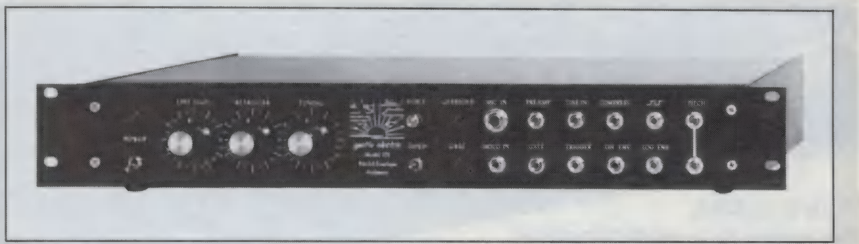
Late-'70s: Oncor's "Touch" guitars and basses were notable for not having strings at all! Instead, metal strips embedded in the neck sensed when different note positions were touched. The right hand played thin metal springs to gate notes on and off. The Touch instruments had very fast response times, but the unnatural feel and poor sound quality of the built-in synthesizer kept them from being successful.

The Roland GR series are the best-known and most successful guitar synthesizers to date. They all rely on P/V conversion and directly-connected synthesizers. The GR 700 has a limited MIDI interface as well (it sends Note On/Note Off data; pitch bends are quantized to semitones).

The Korg X-911 connected directly to any electric guitar. It used both monophonic P/V and direct processing of the guitar signal. The X-911 was cheap and could provide some good sounds, but tracking and response time were not up to most guitarists' expectations.

Mid-'80s: A prototype JTG guitar was shown at the June '84 NAMM show, and created quite a buzz. It was the first "modern" controller that did not use P/V, and tracking was apparently quite fast. It is still scheduled for eventual introduction.

Fairlight's Voicetracker ($2,495 list) is a monophonic Pitch-to-MIDI converter with many extras. No special pickup is provided, or apparently needed (although clean technique is an asset).



Gentle Electric Model 101 Pitch/Envelope-to-Voltage converter, an early device for interfacing guitar (and other instruments) to control voltage-based synthesizers.

IVL's Pitchrider 4000 (marketed by Cherry Lane) is a rack-mount monophonic pitch-to-MIDI converter designed for flute, voice, etc. (although you can persuade it to work with single-note lines on guitar). the Pitchrider 7000, distributed by Kramer, is a hex version for guitar that performs pitch-to-voltage conversion on signals derived from a hex pickup mounted on the guitar.

Synclavier's guitar interface is based on Roland's GR-series standard and provides excellent performance. Several other manufacturers make controllers for the Roland system, including Steinberger, Gibson, Hamer, and others.

Britain's SynthAxe is the most avant-garde guitar to date. It sports an "ergonomically" re-angled neck, largely plastic construction, and a generally Cubist appearance. There are separate sets of strings for the left and right hands, and a set of pressure and velocity sensing "accordion keys" that allow totally new right hand techniques. The SynthAxe uses wired frets and various sensors to detect string pitch bending, dynamics and other parameters. No audio output from the strings is available. The original list price (without synth) was estimated at $10,000, but a less expensive version may be in the works.

Octave Plateau's OP MIDI Guitar (estimated list about $2,000) uses wired frets and other sensors for dynamics and string bending. It also features an alphanumeric display, keypad, and other controls mounted on the guitar body. There is a built-in program stepper and many other features. Several kinds of string audio output are provided, including a standard magnetic pickup.

The Ibanez P/V MIDI Guitar (around $1,100 list) seems to have excellent performance for a P/V type instrument. It has been released as part of a family of MIDI products (MIDI-controlled processors, effects switchers, and footswitches) designed with the guitarist in mind.

Furthermore, if you're mixing the guitar and synth sounds together, bending strings may (or may not) cause them to go out of tune with each other. Try before you buy! For me, though, the ability to use string bends to control anything a synth can do more than justifies putting up with this problem.

Some F/W controllers store sets of alternate tunings (octave shifts, different transpositions for each string, etc.) in memory for instant use. If the unit provides string sound, you can even use one tuning for the string sound and another for the synth sound.

In case you wondered if you can retrofit an existing guitar for F/W technology, my advice is to forget it. The body would have to be carved out to hold new circuit boards; the neck would have to be channeled for the wires, and so forth. On a custom basis, that would cost more than buying a new controller body designed to be wired—and your guitar would never feel or sound the same again.

OPTICAL

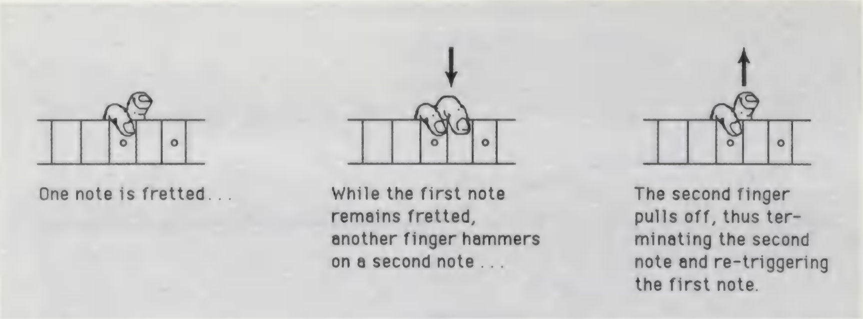
Not much information was available about optical guitars when this article was written. Optical technology in general is very fast and precise, and may very well provide advantages over F/W technology. If optical pickups are used simply to feed string vibrations into pitch measurement circuitry, you would probably encounter problems similar to current P/V units; but if optical technology is used to measure string length and/or fretting, then we might really have something.

PART 3: MIDI AND THE GUITARIST

MIDI Makes a Difference

Basically, MIDI is a special language used by musical devices to tell each other what to play. MIDI is the "magic link" that connects the guitar controller to a whole world of devices out there—at least in theory. As many keyboard players have discovered, though, MIDI devices often speak different dialects, and the differences can greatly affect a device's usefulness to guitarists.

Virtually everything will turn notes on and off and play pitches correctly. Some devices don't respond to velocity (dynamics) information, or bend pitch exactly the same way, or support the optional advanced features of which MIDI is capable. Unfortunately, you really need some of those advanced features for a guitar controller to work well. And both the controller *and* the synth have to have those features—if a synthesizer can bend pitch, that won't do you any good if the guitar can't send it pitch bend information to tell it how much to bend pitch.



One note is fretted . . .

While the first note remains fretted, another finger hammers on a second note . . .

The second finger pulls off, thus terminating the second note and re-triggering the first note.

Fig. 4

BE A MONO MANIAC

The most important advanced feature is Mono mode (see sidebar for information on MIDI and MIDI modes), where each guitar string can individually control a separate synth voice for individual pitch bending and finger vibrato. More importantly, Mono mode lets you articulate cleanly, with hammer-ons, pull-offs and slightly sloppy playing sounding about like they do on a regular guitar.

With Poly mode, all strings control the same set of voices. Triggering a new note causes a synth voice to be assigned to that note. If you play one note and then another on the same string, the first note will fade away naturally (instead of being chopped off abruptly) while the new note attacks. If you're playing notes on two different strings, this is what you want. However, doing a hammer-on/pull-off combination on the same string in Poly mode (**Fig. 4**) produces *three separate notes* that all overlap each other. Worse yet, you'll get a "popping" effect produced by three separate attacks, instead of the smooth legato sound you expect (**Fig. 5**). You can work around this by setting the synth envelope Sustain to full and Release to zero. However, this limits the sounds you can use.

In Mono (Mode 4), with the same hammer-on/pull-off, one voice plays all three notes and the envelope is only trig-

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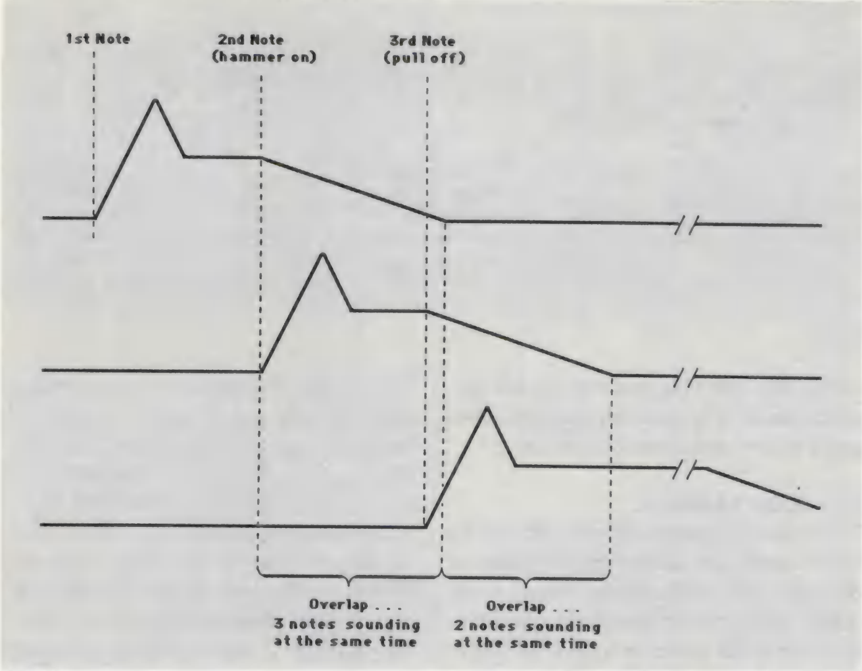

1st Note
2nd Note (hammer on)
3rd Note (pull off)
Overlap . . . 3 notes sounding at the same time
Overlap . . . 2 notes sounding at the same time

Fig. 5

gered once, at the first "B" (**Fig. 6**).

This affects chord playing as well as lead work. When you fret a barre chord, the index (barre) finger often frets first, followed by the other fingers. Unless your picking is extremely precise, false notes will sound briefly. With Mono mode, the false notes will slide into correct ones quickly, without any extra attacks to call attention to them. In Poly mode, the false notes will hang on for the length of the Release setting, and a second set of attacks will occur for the correct notes as they're played by other fingers. This is even more of a problem if you're playing in a "touch" mode: there's no strong pick attack to help the controller distinguish the false notes from the ones you want. Poly Mode can make a great guitar controller sound like garbage, so don't use Poly mode if you can possibly help it!

Most Mono mode devices also let you use several different synth timbres at the same time—a different one on each string, if you like. This is nice but not essential. The main reason for Mono is to ensure proper articulation.

Mono Mode does place more of a demand than Poly mode on the synth, the controller, and on MIDI itself. For example, it's possible (though unlikely) for slight MIDI delays to occur with six channels of Mono data that wouldn't occur with the same data sent in Poly mode over one channel. Nevertheless, the benefits of Mono mode are so great that it's well worth the hassle of finding equipment that speaks Mono MIDI and works well together.

A CONTROLLER IS A . . .

There are actually two different kinds of controllers. All along, I've been talking about guitar controllers, but in the MIDI language, the word *controller* has a special meaning and refers to functions (like pitch and mod wheels, keyboard aftertouch, foot pedals, and so on) that alter the sound in some way. Synthesizers offer a great deal of controllers, because to add a function usually means just adding a potentiometer or switch. With guitars, where MIDI controller signals must be derived from the string data, generating MIDI controller data is far more difficult.

Basic guitar controllers only transmit MIDI pitch bends, while more advanced models have special devices like MIDI vibrato tailpieces ("whammy bars"), pressure plates, remote volume pots—and even mod wheels, just like a synthesizer.

Being able to "remap" the MIDI controllers you have is also important. If your MIDI whammy bar sends data as MIDI controller #4 (foot pedal) and your synth only responds to MIDI controller #1 (mod wheel), your whammy bar is useless. If the guitar controller lets you "remap" the whammy bar to send out data over MIDI controller #1, all is well. If you have three or four independent MIDI controllers on your guitar, you'll want to be able to "map" them into whatever MIDI controllers your synth(s) support. Maybe one controller would change pitch bend, another overall volume, a third vibrato, and the fourth sustain—but you would not be locked into only these options as long as you can remap the controllers.

"More advanced models have special devices like MIDI vibrato tailpieces ("whammy bars"), pressure plates, remote volume pots—and even mod wheels, just like a synthesizer"

A product's "MIDI Implementation Sheet" describes what MIDI functions are and are not available. Learn to understand it! You'll have a much easier time getting a working, reliable system together.

PART 4: EVALUATING GUITAR CONTROLLERS AND SYNTHESIZERS

To check out general playability—the most important criterion in selecting a guitar controller—I'd suggest the following tests. While doing them, pay particular attention to the following:

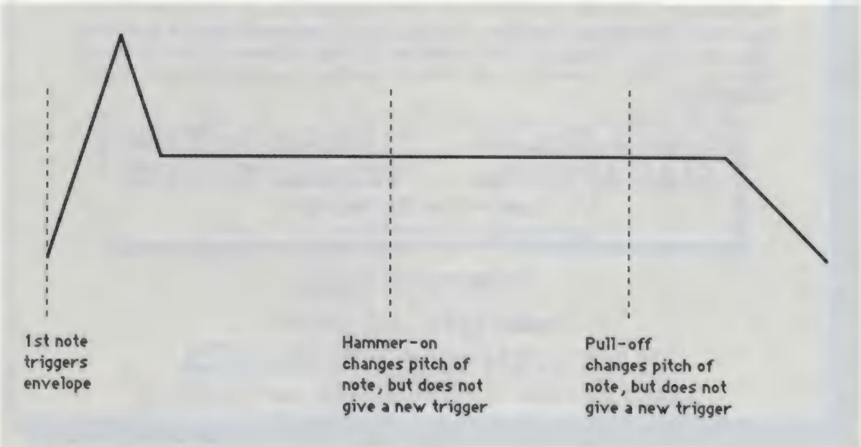

1st note triggers envelope
Hammer-on changes pitch of note, but does not give a new trigger
Pull-off changes pitch of note, but does not give a new trigger

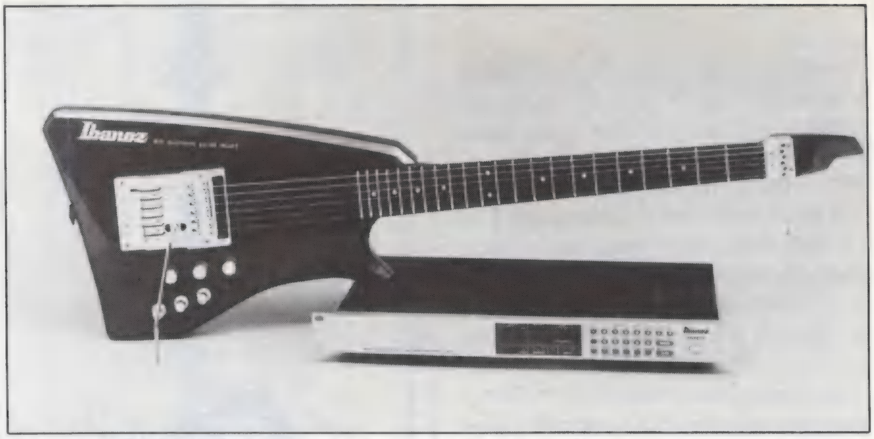
Fig. 6

✓ Does the controller track your playing well?
✓ Does it respond quickly to new notes, or is there a noticeable delay before the note begins?
✓ Do "funny notes" or glitches happen?
✓ Does anything unpredictable happen as you play? If so, try to figure out the reason and if it will be a problem.
✓ Does it feel like a *musical instrument*?

Don't expect the controller to gloss over things you can't play on a normal guitar. Be honest about how cleanly you can play fast scales, and so forth. On the other hand, look out for controllers that unduly magnify small imperfections in your technique.

Use a *punchy* sound (organ patch, percussion, slap bass, etc.) for these tests, unless stated otherwise. Edit the sound for zero attack so any tracking delays will be more noticeable.

Make sure to operate *both* the controller and synth in Mono mode 4 (Omni OFF/mono), if at all possible. You can still check tracking in Poly mode, but if your only option is Poly mode, make sure the synth Release times are very short to minimize problems. Here are a dozen useful tests:



Ibanez IMG2010 MIDI Electronic Guitar and IMC1 Controller

1. Speed test: Play a rapid mandolin-like trill on one string (same note). Do this for all six strings, playing both open and fretted notes.
2. Delay: Play single low notes percussively throughout the low register and listen very carefully to the attack. The less delay between plucking and hearing the sound, the better.
3. Dynamic response: Play at different dynamic levels, all over the guitar. Try both single notes and trills. Find out where the triggering gets flaky. (Note: Adjust the guitar to your playing style for this test to be fair).
4. Sustain: Play and hold both low and high notes. Listen to when the synth note shuts off. Check to see if there's an adjustable threshold (or different playing modes). Check to see how much the initial loudness of the note affects sustain.
5. Tracking test #1: Play alternating trills of different intervals, hammer-ons, and pull-offs, all over the fretboard.
6. Tracking test #2: Play fast scales, both legato and staccato, all over the fretboard.
7. Ability to handle chords: Play a full chord (open "E," for example), then try different chord riffs and sliding chords

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around.
8. Pickup separation test for P/V devices: Play and hold a note on one string, then trill a note on an adjacent string. Listen for any interaction between the two.
9. Sensitivity: Try two-hand "touch" playing (both hands on the fretboard). How soft can you play with good results? What kind of problems do you encounter?
10. Pitch bending test: Try pitch bends and finger vibrato. Can the controller handle wide bends without problems? Does pitch bend smoothly, or does it jump abruptly between semitones? Make sure the synth and guitar are set up to respond to each other properly.

If the controller outputs audio from the strings, listen to both the synth and the string tones while bending, and see if they track each other. Check this all over the neck.

11. MIDI controller flexibility: Test whatever special controllers the guitar has (pressure plates, whammy bars, etc.). If you can remap the string bend to control other synthesizer parameters, try that as well.

(Right) Octave Plateau MIDI Guitar Controller

12. Harmonics test: Try playing harmonics (natural or octave). This is a nasty test: Anything except P/V guitars will probably play the open/fretted note and NOT the harmonic. You can turn this to your advantage sometimes if the controller produces audio from the strings, since you can mix string harmonics with normal-register synth sounds.

In addition to all the functions covered so far, here are some additional features to look for in a guitar controller.

✓ Special playing modes. These can include picked vs. "touch" styles; different settings for chords vs. melody to avoid glitches; or "infinite sustain" and various other effects.

✓ Program change capabilities for synths. This lets you change synth sounds from the guitar. Steppers that store sequences

Guitarists' Guide to MIDI Basics

The Musical Instrument Digital Interface is like the telephone: you can use it without getting knee-deep into technical stuff as long as you remember how to dial.

Several years ago, a group of manufacturers developed MIDI so that musicians could play one synthesizer's sound generating section from the keyboard of an entirely different synth. Thus, one keyboard could control multiple synths—you wouldn't need a keyboard for each synth anymore. Since that time, MIDI has grown by leaps and bounds, often doing things the original designers never intended.

When two devices are MIDIed together, one can tell the other what to play. MIDI has basic "words" to tell when a particular note begins (NOTE ON command), and when that note ends (NOTE OFF command). The NOTE ON and NOTE OFF "words" can also include the velocity (loudness) the note is played with, if the device provides this data. Special "words" describe the amount of pitch bend, mod wheel or sustain pedal positions, patch data within the synthesizer, and many other functions including timing and synchronization. Most devices don't use or recognize the full vocabulary of MIDI "words," and ignore the ones they don't recognize.

What kind of devices speak MIDI? The current list includes synths, samplers, remote keyboards, drum machines, lighting controllers, reverbs and DDLs, pedal keyboards, mixing boards, computers, and of course, guitar controllers. While connecting your guitar to a lighting controller might not be very useful, it's nice to have that flexibility.

One MIDI Out feeds one (and only one) MIDI In. You can't use a "Y" adapter with digital data as you can with audio, however inexpensive MIDI Thru boxes (see Kirk Austin's article in this issue) let one MIDI source drive many different devices.

Up to 16 different "channels" are available on each MIDI line, just as a TV can tune in different channels being carried on a single antenna or cable. Normally channel distinctions are ignored when you turn equipment on, so that devices "listening" on one channel can respond to commands sent out by devices "talking" on a different channel. (This is called "OMNI ON Mode"). However, sequencers need to be able to carry on separate "conversations" with a group of synths and devices on the same MIDI line in order to orchestrate songs. To do this, most devices can be set to "listen" only to commands coming in on one particular channel (this is called "OMNI OFF Mode"). Don't worry about how MIDI handles 16 different "conversations" on one cable—Ma Bell can put thousands of conversations on two wires!

There are two other MIDI modes. *Poly* mode allows chords and polyphonic lines to be sent on a single MIDI channel and is the most commonly used mode. However, it's not so good for guitar, because it can't tell the synth which notes belong to which strings. *Mono* (also called Mode 4) only allows *one* note to be played at a time *on each channel.* Sending another note automatically turns off the previous note, even if no NOTE OFF command was sent. Since this is what happens when you slide your finger up a string, Mono Mode is a natural for guitar controllers. Six different MIDI Channels are used, one for each string. When you bend a string, the pitch bend "words" are sent out on the Channel assigned to the string you bent, so that the synth can tell which note to bend and which to leave alone.

Remember, though, that MIDI is still evolving. Manufacturers are working hard to refine it to better handle guitar controllers and other special requirements. Over the next year or so, new ways of helping guitar controllers and synths talk to each other should develop, which will provide us with even greater expressive control.

of programs can be extremely helpful for live performance.

✓ Ability to store guitar "setups"—different combinations of MIDI modes, tunings, controller maps, etc.

✓ Ease of making changes. More advanced controllers will have lots of bells and whistles, but using them can be a delight or a nightmare depending on how much effort was put into making them easy to use.

✓ Indicators and displays. It's hard enough learning a completely new technology; having a comprehensive display that informs you of the guitar's status and control settings can be a real boon, even if they initially seem to make the instrument more complicated.

That seems like a lot to check out... and it is. But remember: most of you are diving head first into a world that keyboard players have had years to figure out. Relax, have the salesperson give you a tour, and explore all the options before you make a decision.

CHOOSING A SYNTHESIZER

There is no such thing as the best synth in the world; most of choosing a synth involves your personal taste. To my ears, digital synths sound crisp and often do great "acoustic" sounds, while analog synths are usually warmer and often do the best strings—but the bottom line is that both approaches are great, and samplers can expand your options even further. The best advice I can give is to check out everything you can with a reasonably good sound system, and *use your ears.* Don't depend on what others tell you—they probably have different tastes.

> *"Unless you're really into 'modular' synthesis equipment, you're probably better off with a MIDI synth"*

However, there are some specific features you can check. First off, the synth has to speak MIDI, unless it's actually part of the guitar controller/synthesizer. MIDI adapter boxes can let you control older CV/Gate equipment from MIDI, but unless you're really into "modular" synthesis equipment you're probably better off with a MIDI synth. Such converter boxes may not handle MIDI Mono mode anyway.

You also need at least six "voices" in order to ensure a sound generator for each string of the guitar. In some cases, you can gang two four-voice synths (such as Casio's CZ-101) together.

As discussed earlier, the synth needs to handle MIDI Mono mode for at least six channels, or even the best guitar controller will appear to play badly. Most synths don't do this, and even those that do may not handle pitch bends properly. For example, the Sequential Circuits Six-Trak cannot respond to individual pitch bends on different strings, although it handles other articulation properly and shouldn't produce the popping effects and "smeared" notes characteristic of Poly mode.

Synths that don't handle Mono mode include virtually all Korg and Roland synths of which I am aware; Yamaha synths except for the TX816 rack (including the DX7, except as noted below); and most other synths and samplers. That's quite a list, but to be fair, most synths were not designed with guitar players in mind.

> *"Most synths were not designed with guitar players in mind"*

So what will work? The Oberheim Xpander works fine (the needs of guitarists were considered during the design phase of this product); so does the Casio CZ-101 and CZ-5000 (although CZ-101s only have four voices in Mono mode, so you'll need two of them to handle a guitar). The E-Mu Emulator II sampler also works. Yamaha's TX816 rack does well, as long as you have at least six modules, and set them up properly. The Sequential Six-Trak works okay, keeping in mind its limits with pitch bends. All of these will allow independent sounds for each string if desired.

The Yamaha DX7 has a limited form of Mono mode: it only recognizes one channel, and you can only play one note at a time. This isn't very useful for guitarists (the TX816 modules work similarly, which is why you need six of them). However, a company called Gray Matter Response makes a special software modification for the DX7 that adds many useful functions, and they plan to support a six-voice Mono mode in their next release. This mod would make a DX7 act like a Six-Trak; however, all six strings will have

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the same sound, unlike the Six-Trak and TX816 rack. There's some possibility that Yamaha's TX7 expander module may have a similar mod available sometime.

There are strong rumors of several new Multi-Timbral synths coming out this spring. While there hasn't been a lot of demand for these products until recently, guitar players and sequencer fans are all hungry for them, and manufacturers are listening. By the end of 1986, there should be a wide variety of choices at all price points.

If the synth is an expander module (doesn't have a keyboard) you can probably save some bucks if you only plan to control it with guitar and have no need for a keyboard. This also gives a more compact setup. However, some expander modules don't allow for sound editing (for example, the Yamaha TX7 only loads sounds from cassette or over MIDI; you need a DX7 or computer program to actually edit the sounds).

Other desireable features include a wide variety of MIDI controllers, such as MIDI-controllable master volume, aftertouch, portamento, and so on. Some synths let you program an "instant access" parameter for every patch: this can make it easy to change attack time directly from the guitar with one sound, and filter cutoff or waveshape with others. Again, this isn't useful unless the guitar controller can handle it.

And, of course, check out the sound (that *is* why you want to get wired, isn't it?). *Never* go on the basis of what a synth sounds like when played by a keyboard player. Always drive it from a guitar controller to hear how it sounds when *you* play it.

This doesn't mean you should just play all your favorite guitar licks, of course. As many keyboard players learned the hard way, you can't make a trumpet patch sound realistic if you're not playing trumpet licks. In fact, much of the art of playing synthesizer lies in learning what "sounds natural" for each type of sound. Don't be intimidated—learning to hear through others' ears can be tremendously exhilarating! But it does take time, careful listening, and lots of experimenting.

PART 5: PUTTING IT ALL TOGETHER

Now that you have a controller and synth picked out, what else do you need?

Maybe you've noticed that keyboard players don't use Fender Bassmans any more. Guitars and synths have radically different requirements for sound reinforcement (except for people like Jan Hammer, who use guitar amps to make synths "rock out"). To get the best sound from your new guitar synth, try using a clean feed direct into the board along with your regular setup for the guitar sound. Live performers may want to add a standard keyboard amplifier system if the stage sound system isn't adequate.

> *"Never go on the basis of what a synth sounds like when played by a keyboard player"*

Also, synthesized sounds tend to sound flat without "ambience" processing such as reverb and chorus. Some guitar gadgets work fine with synths, others don't. There are some terrific new digital reverbs available—guitar amp spring units definitely won't do you justice. There are also some black boxes that process MIDI data (not sound) to produce arpeggiation, harmonizer and echo effects (see the ME10D review in the February 1986 **EM**). These units may not respond well to Mono mode, however, so be careful.

Anyone adventurous enough to explore guitar synthesis owes it to him or herself to check out sequencers as well. Unfortunately, fully discussing sequencers is way beyond the scope of this article. There's a tremendous variety available; some are computer programs and others are self-contained boxes...some even print out lead sheets. In fact, I expect sequencers to change music as much as electric guitars and synths have, and a good guitar controller will let you use them to the max. But be careful: sequencers (like synths) don't always handle MIDI Mono Mode very well.

It's a virtual certainty that improved technology will come along over the next few years and obsolete the current generation of guitar controllers. However, as with computers, synthesizers and other high-tech items, the ground rule is: *Buy the best product available that suits your needs, when you need it, and don't buy anything until you have a real use for it.* If you can use a guitar controller now, and current products will fill your current need—then go for it! Don't wait too long on the promise of technology "just around the corner" that may or may not show up. On the other hand, if you don't have a real need, or don't know enough to make a good decision—wait, learn as much as you can, and make an informed choice when the time comes. For most guitarists, buying a guitar controller will mean getting into a whole new technology of synths, accessories and MIDI interfacing. Be prepared, know what you're in for, and you'll have a great time making some great music.

GLOSSARY

ADSR Acronym for Attack, Decay, Sustain, Release, the most common form of synthesizer Envelope.

Channel A way to separate MIDI data on the same cable so that it can be routed to different devices. See MIDI sidebar.

Controller (1) An instrument that feeds information to and triggers a synthesizer; (2) Bend levers and other gadgets used to add expression; (3) MIDI "words" that describe the synthesizer's physical controller movements.

Cycles The repeating pattern in a sound which creates the perception of pitch is measured in cycles. The more cycles per second, the higher the perceived pitch (usually).

Deadzone Pitch bend wheels found on keyboards often have no effect for a small distance around the center zero (no pitch bend) point. This "deadzone" helps avoid tuning errors if the springs do not pull the wheel back to the exact zero point. Since guitar strings do not have a "deadzone," bend signals from a guitar controller may have no effect for small pitch deviations.

Envelope All musical sounds have patterns of dynamic change in them which make them interesting. These patterns are often called "envelopes," and the circuit that generates them in a synth is called an "Envelope Generator" or EG. Synths should have two EGs per voice for interesting sounds. See "ADSR."

Implementation The spec sheet that describes what MIDI "words" are recognized by a particular device. This one page form is often found in the back pages of the Owner's Manual, so look carefully for it.

MIDI The Musical Instrument Digital Interface, used by music products all over the world. See MIDI sidebar in body of article.

Mode There are two kinds of MIDI Modes: Omni ON/OFF and Poly/Mono. Guitarists can use Poly mode if they have to, but Mono Mode (Omni OFF), also known as MIDI Mode 4, works much better for guitar controllers. See the MIDI sidebar and "Be

—page 31

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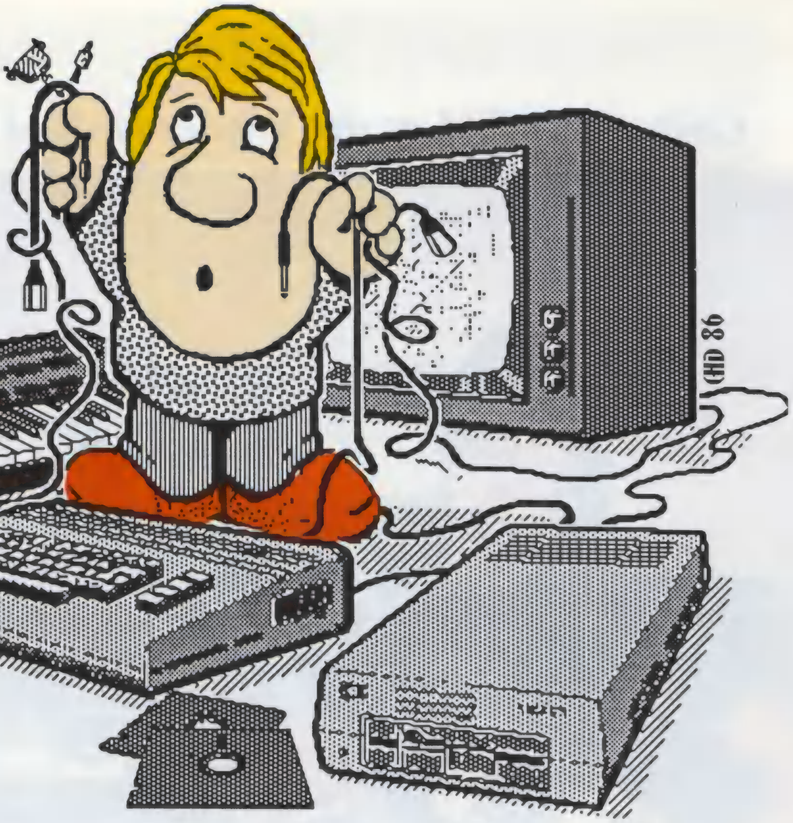

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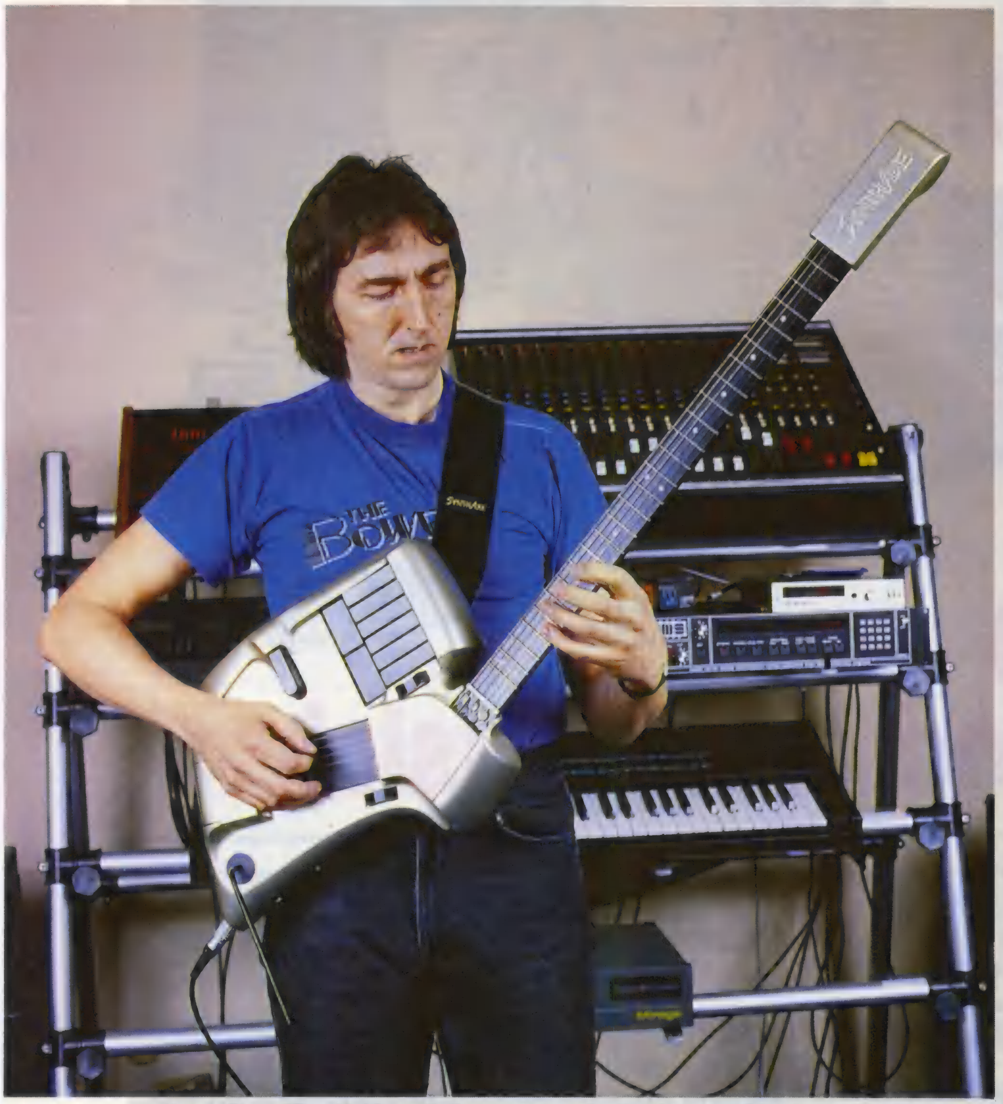
Guitar-to-MIDI at the Winter NAMM



Guitar hero Allan Holdsworth demonstrates the SynthAxe at the winter NAMM in Anaheim, CA.

PHOTO: SHERRY BARNETT

As predicted, guitar-to-MIDI came into its own this January at the Winter NAMM show in Anaheim. Crowds flocked to the Pitchrider 7000 demos at the Kramer guitar booth, and the new Ibanez MIDI guitar gained equal attention. Roland's bass synth, with a separate processor for each string, showed that strings-to-MIDI was for more than just guitarists, and JTG said that their guitar synth was still alive and would be introduced eventually.

There were some surprises at the show, too. Akai introduced the GTM6 guitar-to-MIDI rack mount, currently designed for use with Charvel guitars. The string pickup system is piezo-based, and takes the form of a new saddle for the guitar's bridge. You can assign different strings to different MIDI channels, and there are some special features such as a built-in guitar tuner accurate to one cent, arpeggiator, infinite hold, simple sequencer for holding repetitive patterns, and a repeat mode. List price is $1,295.

The Photon guitar made its debut—sort of. Although neither I nor anyone I talked to saw it actually working, according to the company the pickup system is essentially the optical equivalent of a pitch-to-voltage converter. They get around the delay problem involved with analyzing low frequency waveforms by using high E strings for all the strings on the guitar; the rack mount "brain" transposes the second through sixth strings to give a standardly-pitched guitar output. It was kind of strange playing uniform gauge strings, but I'm sure after a familiarization period one would get used to it.

SynthAxe, makers of the first guitar-to-MIDI *controller* (not just a standard guitar with a hex pickup attached) are about to begin quantity production of the instrument. Allan Holdsworth was at the show and demoed the instrument, which he uses on his new album, *Atavachron*; even a casual listener couldn't help but notice that the response was much faster than that of traditional pitch-to-voltage converters—as befits an instrument that costs about the same as a new car. To me, though, the most interesting aspect of the SynthAxe is that it represents a significant departure from traditional thinking. The shape, the angle of the neck, even the fret spacing is different from a traditional guitar and optimized for the SynthAxe's use as a controller. There's also a "mini-keyboard" (with velocity and pressure sensing) for sustaining any individual string, additional keys for sustaining the upper and/or lower three strings, and a "tap" mode for playing a la Emmett Chapman or Stanley Jordan. All in all, this is an imaginative—although pricey—solution to guitar-to-MIDI conversion.

Finally, although Octave-Plateau didn't exhibit at the Winter NAMM they did have informal showings of their guitar controller at a hotel suite. The guitar is close to completion, and has a new body design that is a great improvement over their prototype shown last summer in New Orleans. One of the instrument's major contributions to the state of the art is the inclusion of many MIDI programming controls on the guitar itself. Thus, changes can be made "on the fly" while playing instead of having to go over to a rack-mount control head and punch buttons or spin knobs.

It looks like widespread use of guitar-to-MIDI is just around the corner . . . the next few months should be interesting.

—Editor

—from page 28, Guitar Synthesis

A Mono Maniac" part of the article.

Monophonic Capable of playing only one note at a time. The guitar can be viewed as a set of six monophonic instruments, or strings. Sounds weird, but it's easier to control synths when you use that viewpoint.

Note ON, OFF MIDI commands that tell a synth when to start and stop playing particular notes. Exactly when a note sounds is determined by the Attack and Release times of its envelope.

Patch The collection of control settings that determines the character of a particular synthesizer sound. Derived from pre-MIDI synth technology, where different modules were physically patched together using (what else) patch cords. Current synths can store anywhere from 32 to several hundred different patches (also called "programs") in memory. Any of these patches can be selected by MIDI command.

Pitch acquisition delay The length of time it takes a pitch converter to detect a change and respond after a note is played, bent, etc. This usually takes at least two to three cycles.

Pitch bend matching The accuracy with which the pitch of sound produced by a bent string agrees with the pitch of a synth sound controlled by the same string.

Pitch-to-Voltage Conversion A process that measures the actual pitch of a sound and produces a voltage corresponding precisely to that pitch, for the purpose of controlling a synthesizer. Usually also detects amplitude and note on/off information. Modern pitch-to-voltage converters are actually digital pitch detectors that produce digital MIDI signals directly, without producing a control voltage.

Synthesizer An instrument which produces sound electronically, and which permits the user to alter many or all of the various aspects (parameters) of the sound's tone color.

Taper The curve indicating how something responds. Pitch bend wheels (and strings) have characteristic tapers which greatly affect the "feel" of how you bend pitch. Small movements may create little or no bend at first and greater bends later, or exactly the reverse, all depending on the taper.

Touch style A style of playing notes by tapping on the fingerboard, without picking the note. Allows both hands to control pitch, and generally permits much faster playing.

Voice In a synthesizer, the set of "building blocks" that work together to create a single note. A monophonic (one voice) instrument can only play one note at a time. A six voice synth can play six notes simultaneously. Some people use "voice" instead of "patch" (my synth has 99 voices—how about yours?) because the process of creating patches is often called "voicing."

REFERENCES FOR FURTHER READING

MIDI For Musicians, by Craig Anderton, Music Sales. An excellent all-around book about MIDI, from how it works to what you need to know about many kinds of MIDI gadgets.

"Fairlight Voicetracker and Cherry Lane Pitchrider," Steve Cummings, *Keyboard* magazine, December 1985. Reviews of two P/V devices.

"Making MIDI Work for You," Alan Campbell, *Electronic Musician*, June 1985. This is a good practical guide with lots of advice on surviving in a MIDI environment. Virtually all issues of *Electronic Musician* include some type of MIDI or synthesis related articles and reviews.

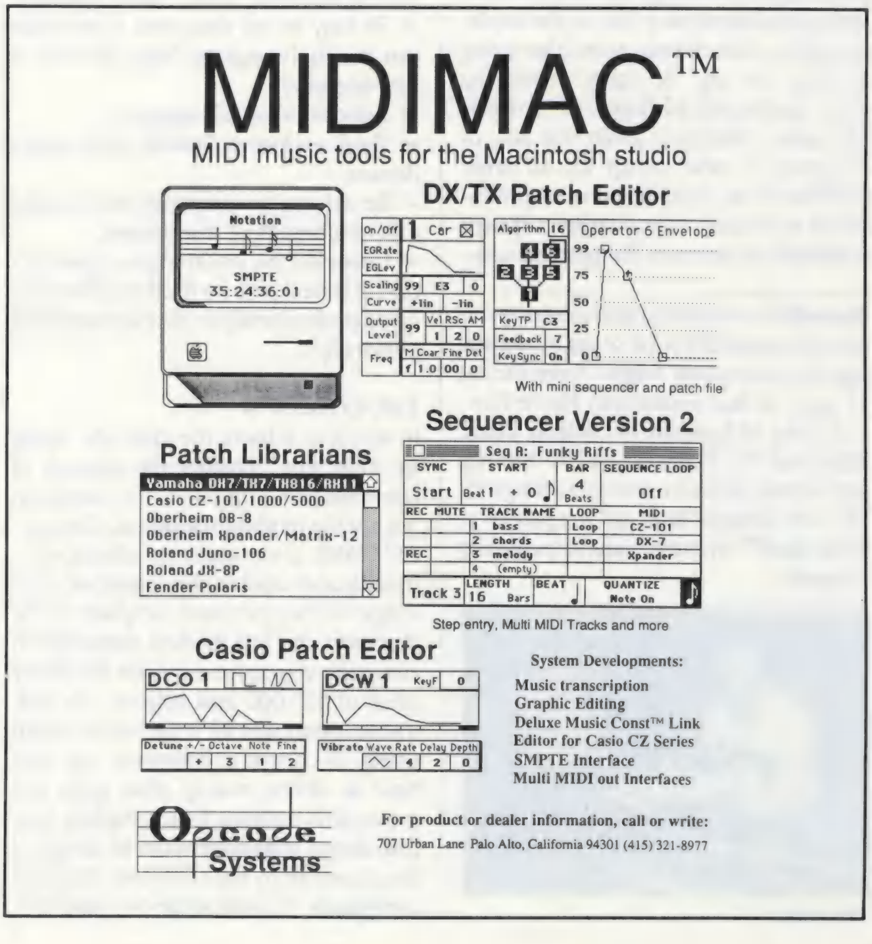
August 1985 issue of *Musician* magazine. This has a special section on MIDI with some great articles by Craig Anderton, Freff, and others.

June 1985 issue of *Keyboard* magazine. Almost the entire issue is devoted to how to program different types of synthesizers. A similar special issue, January 1986, covers MIDI as it applies to keyboards.

"What MIDI Means for Musicians," Jim Wright, *Polyphony*, June 1983. This article refers to an early version of MIDI (before the current spec) but still has some useful information. It's distributed by the IMA (see below) as part of their literature pack.

International MIDI Association, 11857 Hartsook St., North Hollywood, CA 91607. Tel. 818/505-8964. The IMA is dedicated to gathering and spreading accurate information about MIDI, and work with users, retailers, techs, educators and manufacturers. They publish a monthly bulletin, the MIDI 1.0 Specification, and the MIDI 1.0 Detailed Specification (which includes much more information on MIDI's technical aspects).

There are several available books on synthesizers; check with local book and music stores. EM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Here's how MIDI simplified life, and opened up previously unexplored creative possibilities, for the New Santana Band.

Santana's MIDI Guitar Composition System

BY BRYAN BELL

When I first became a professional technician for musical groups, all of the special signal processing and effects were designed for guitar. Many keyboard players went through great pangs of jealousy, and a few technicians such as myself soothed their pains by adapting "guitar effects" for their setups. Now the tides have changed, and guitar players are reaching out to the ever-growing world of the synthesizer. "MIDI this to MIDI that—the ultimate in flexibility—the answer to all musician's dreams"... promising words, but I only wished they were all true!

Trying to decide on which instruments to purchase and use has always been a difficult and complex issue. Nowadays, music technology has accelerated at such a breakneck pace (due to the implementation of microprocessors) that trying to keep "on top" of signal processing alone has become a full-time job. To make life easier, whenever given the task of designing a new set-up for an artist (whether it be for an amateur or professional musician), I try to create a system of thought to structure the problem-solving process. My method is very simple (thank heavens!): start at the finished product, and try to describe how happy you are with the end results and enumerate all the features and power that the system delivers to the artist's fingertips—then work backwards to see how you got there.

***Bryan Bell** is an engineer/producer/programmer who specializes in live sound mixing and high-tech instrument design. During the last 11 years, he has worked with Herbie Hancock, John McLaughlin, Al DiMeola, Earth, Wind and Fire, Kalapana and the Berkeley Jazz Festival. Bryan is currently working with The New Santana Band and is a partner in Synth-Bank™, an online sound file publishing company.*

PHOTO: RANDY BACHMAN

Bryan Bell

My current project is an extension of earlier work on the search for the ultimate composing machine, in this case as applied to the guitar. With the truly "ultimate composing machine," you would just think about the music; it would write out the parts, record the music, and sell two million copies. Well, maybe that's asking a bit too much, so let's call this project the practical composing machine (but it never hurts to dream a little). The practical composing machine needs certain qualities:

✓ So easy to use that even a musician can run it (computer lingo for this is user-friendly).

✓ Generate musical notation.

✓ "Feel" as close as possible to the artist's desires.

✓ Be universally compatible with several different brands of instruments.

✓ Cost-effective (meaning in a given period of time it pays for itself in either time saved professionally or pleasure rendered personally).

THE COMPUTER

In trying to achieve the ideal end result, we must first consider the concept of universality as it applies to the computer, not just the musical instrument. Computer?!? Well, if we want something user-friendly and capable of notation, we need the power of a personal computer. A few years ago, the first musical transcription computer was announced for the pretty price of $25,000 and believe it or not, transcription was all it did! Now, when trying to choose a computer, you first have to define exactly what tasks you expect this machine to accomplish. Your first choice will concern the bit length of data handled by the computer. Eight bit computers (Commodore-64, Apple II, Atari 800XL, etc.) are exciting as long as you don't ask them to do too much. When you do, you quickly learn about their big brother, the 16 bit computer. For complex functions such as sequencing, notation and master control, believe me, a 16 bit computer—with its extra resolution and data crunching ability—can be a musician's best friend.

Right now there is a whole new barrage of personal computers all based upon the Motorola 68000, a 16 bit microprocessor chip that works like a 32 bit chip internally. The Apple Macintosh, Commodore Amiga, and Atari 520ST all employ basically the same caliber of hardware. For the composition system, I chose the Mac on the basis of familiarity, ease of use, and software availability. Having a Mac immediately solved the sequencing problem, as Opcode, Total Music, Mark of the Unicorn, and Musicworks all make sequencing programs. Notation can be provided by Professional Composer; there are also patch librarians (such as Op Code's version). Please do not get me wrong—while I really like the Mac, just about *any* system can expand your musical options and many systems will have the ability to achieve the same general goals. (It is even possible to do most of the job on an existing eight bit system if you have budgetary limitations.)

So we now have a user-friendly master computer. Even if a computer is a little costly, you will get your money's worth through ancillary uses such as word processing, filing, telecommunications, and all that other small business stuff you can run with a good personal computer.

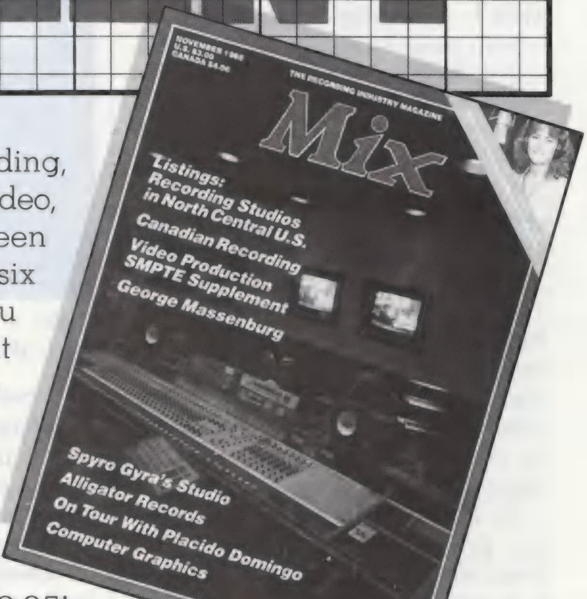
What about universality? MIDI, of course, is the answer. MIDI is great because you can actually plug most things into each other; the only real problem is that it is slow and not all MIDIs are equal. MIDI to me is a breakthrough in terms of politics, but leaves much to be desired for the end user. Still, for now MIDI is the best thing that we have in terms of a standard.

THE GEAR

Now that we have universality through MIDI, and the smarts to control it all via computer, let's address which components to choose for a guitarist's composing system. To create a complete system, you would ideally want MIDI-controlled devices representing the major types of synthesis:

✓ Vintage analog synth (old style Minimoog, Obie synth upgraded to MIDI, etc.)

✓ Computer controlled analog (Oberheim, Prophet, Chroma, etc.)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. . . as well as a few Casio "phase distortion" synths just to fatten things up a bit. Having this variety of instruments delivers a very wide range of tonal resources.

THE CONTROLLER

Last but not least, we need to play the system. In theory, anything that outputs MIDI is a controller candidate, but my current group is the New Santana Band so I think we had better try to trigger this whole collage by guitar. The good news is that Roland makes a reasonably-priced guitar synth system consisting of the G-707 (the guitar section) and GR-700 (the synthesizer section). The GR-700 outputs MIDI and is the main controller for the Santana system. There are alternatives: The Synclavier MIDI interface, IVL's hex Pitchrider 7000 (marketed in the U.S. by Kramer), the Ibanez MIDI guitar, SynthAxe controller, and the elusive Photon guitar. While all of these tackle the difficult guitar-to-MIDI conversion with a reasonable degree of accuracy, I need to stress that so far I have not yet seen a superb real time guitar system. Most of them suffer from a certain amount of delay and inability to perfectly track a guitarist's playing. The Synclavier, although "pricey," is the best to date in terms of technical performance, tracking, speed, and the general ability to translate your guitar playing into synthetic sound. The Roland is special because it brings to the masses the ability to create MIDIfied music through the unusually expressive medium of guitar. The Roland interface is now featured in several different manufacturers' guitar synth controllers (Hamer, Steinberger, Gibson, and probably some others) and is currently the best available choice for custom applications. Those interested in the nuts and bolts of guitar-to-MIDI conversion and some additional opinions should check out Jim Wright's article in this issue.

SANTANA'S SYSTEM

Here's the equipment I've put together so far for Carlos:

✓ Roland 700 and 707. Better controllers are starting to appear, but these do the job. The most recent software revision seems to improve the tracking as well.

✓ 512K Mac (the "Fat Mac") with 20 Megabyte hard disk drive, modem, and printer. 512K of memory is a virtual necessity to efficiently run complex Mac programs; a hard disk speeds up operation greatly compared to using the single microdisk drive built in to the Mac. A modem allows for calling into musician-oriented bulletin boards, or downloading sounds from my patch service (Synth-Bank™). The Imagewriter printer handles text, but can also print out graphics such as music notation.

PHOTO: RANDY BACHMAN

Carlos, at The Plant Studios with his system: Roland G-707 guitar synthesizer controller, E-mu SP-12 Sampling Percussion system, and Emulator II with 512K Macintosh.

✓ Software includes Total Music, Musicworks and Opcode sequencers; Professional Composer notation software from Mark of the Unicorn; and Opcode patch library software. The Total Music sequencer features notation and sequencing. The Musicworks was the first available software for the Mac. The Opcode is my favorite program because of its ease of operation. The Pro Composer software is the most elegant notation program I have ever used. (I have not yet used Performer by Mark of the Unicorn at the time of this writing.) The Opcode library software handles Casio, Yamaha, and Oberheim synthesizers at the moment. Finally, we have Digidesign's Sound Designer for the Emulator II and Mirage Rack Mount. The Digidesign products dramatically improve the instruments' performance.

✓ Other instruments: Emulator II with 10 Megabyte hard disk drive, Ensoniq Mirages, Yamaha DX7, Casio CZ-101, and by occasionally borrowing equipment from the keyboard players, two Oberheim Xpanders, one Oberheim Matrix-12, two Casio 5000s, more DX7s and whatever else we can squeeze in. Drum machines include the E-mu SP12, LinnDrum, Yamaha RX11, and a Linn 9000 when we can get it away from Sterling Crew (one of the keyboard players).

Carlos' system is a top-of-the-line professional composing and performing package which I consider a viable alternative to a Fairlight or Synclavier. But you don't need this much power in order to create a useful composition system (I am currently putting together an Apple IIe system for Tony Williams and Commodore 64 system for Chester Thompson), and if even these seem out of reach, rest assured that costs will continue to decline. Remember, the microprocessor was only introduced in 1977, yet prices have dropped dramatically in a very short time. Because guitar controllers are based on microprocessor technology, I expect these controllers to mirror trends in the computer industry and become faster and more accurate, and cost less, as time goes on.

THE APPLICATIONS

The Santana system is particularly useful because each piece can provide a valuable "stand alone" application. The Mac is used everyday as a word processor (lyrics, tracksheets, memos); we also use a modem and telecommunications software to keep in touch with electronic bulletin boards for software updates and gossip about new technology (as well as to download sound files and effects). On tour, the computers provide daily communication between promoters, trucking, sound and lighting contractors via electronic mail.

Carlos enjoys playing the Roland guitars as standard guitars as well as controllers. Along with his Paul Reed Smith guitars, the 707s are becoming his favorites. The most exciting "new" parts of his system are the E-mu SP12 sampling percussion machine and Emulator II sampling keyboard with the hard disk drive. The hard disk eliminates the tedious waiting that was inherent in earlier E-IIs. The E-II's internal sequencer is extremely versatile and when connected to the SP12 creates a powerful composing tool. For the new album, *Personal Contact*, the SP12 and E-II sequences were the heart of several of the original compositions. The 707 was MIDIed to the E-II to produce exotic flute and string sounds.

One of the goals we are trying to attain as a band is to combine the keyboard setups for Chester Thompson and Sterling Crew with Carlos' new Mac/MIDI world. The end result (we hope) is to have an extremely flexible and useable composition work station—a place in the studio or rehearsal hall where anyone can walk up to the rig and play drums, keyboard, or guitar and have the system send the sound to audio cassette and the data to several sequencers. From there the data can be edited, transposed, uploaded (via modem to another person not at the session) and played back. Then other members of the group can make suggestions, add new sounds, change instrumentation or even record new musical parts. The beauty of some of the new Mac sequencers is that they have hundreds of tracks available, so everyone can try a particular idea and we can choose the best at the touch of a button. Another advantage to using a computer sequencer is that we can make several different copies in different tempos and keys for singers and other musicians to work with before creating the final version.

A system of this kind is never finished. Right now we are still in the studio and the system has not completely been packaged for touring, so we are in the process of deciding on the last few details like master clocks, MIDI switchers, and so on as this article is being written. In fact, the most difficult part of developing an overall concept for a multi-instrument package is trying to keep all of your future expansion options open. There will always be something newer, cheaper, faster and better coming along, so you had better prepare for it now!

THE HUMAN TOUCH

After all is said and done, it is important to remember that what I have been talking about is more than hardware and software . . . this equipment is being used for *making music.* Most of the artists I have worked for (even though some of them are extremely talented technical musicians) place the major emphasis on creativity. Whether they think it comes from a "supreme being" or a cosmic library or from a place within themselves, they strive to create the mood that makes it easier to become in touch with the unique experience called creativity. People think the machines can make the music they cannot, but machines are tools; people make the music. It is very special when you see an artist for the first time in his life assemble something he heard in his head, not just on paper, but with a complete arrangement of drums, bass, keyboards, orchestration, and melody. The sense of satisfaction an artist gets upon playing back an entire composition from idea to work cassette is hard to describe. To me, moments like those really make doing all of the research and development, the interface hassles, and the endless training sessions pay off. When you realize the world might not have heard a certain piece of music if the right tools had not been there for the artist to capture the spirit, you feel really grateful to have been part of the process of making their dreams become reality.

THE FUTURE

I try to think about "what is the future of MIDI guitar" and all I come up with is an analogy: the electric guitar is like paint and brush to a painter in the Middle Ages, and when MIDIed to all the potential of modern synthesis it is like giving those painters movie technology. (I would like to see what Michaelangelo would have done had Lucasfilms been at his disposal.) As the technical and economic stumbling blocks of guitar synthesis crumble, there will be a new generation of musical creativity released by all the musicians who use the technology.

New technology is hard to adjust to because we have to rearrange the previously-established ways in which we view life. However, I think this adjustment is worth the challenge. The musicians are not the only ones who benefit from an easier-to-use composing system . . . it's the listeners who really benefit. They get the chance to hear all the new music that might not have been possible without it.

(For more information on subjects mentioned in this article, see the Total Music review in the January 1986 **EM***; Professional Composer review in the March 1986* **EM***; Op Code patch librarian review in the March 1986* **EM***; and Peter Gotcher's article "Mac the Axe" in the February 1986* **EM***.)*

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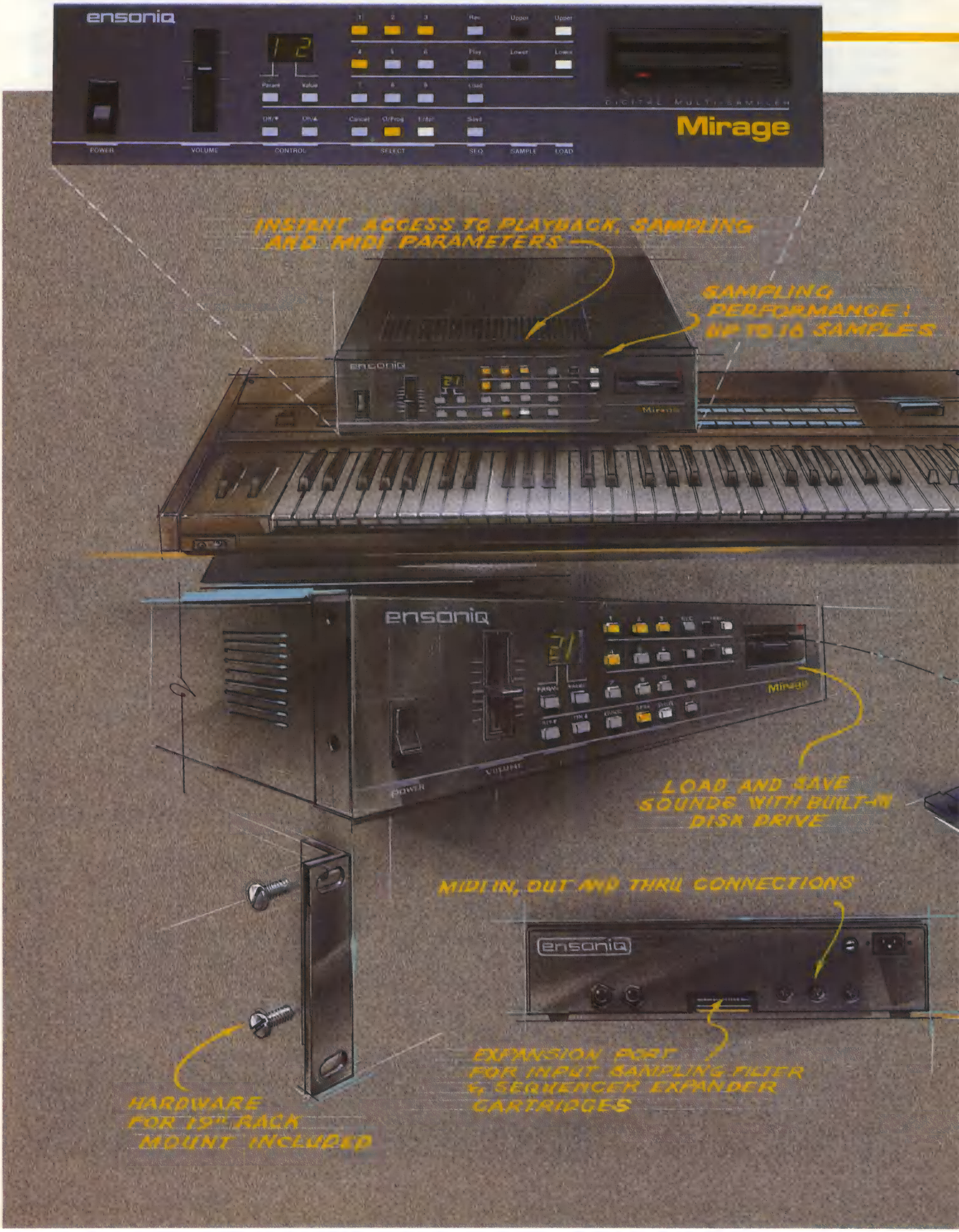
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You heard the rumors, you've heard the hype...now read the facts.

Amiga!

BY DAVID KARR

A brightly-colored red and white animated ball bounces slowly across the screen. As it hits on the left side, a resounding boom—not the usual beep of a video game—echoes out of the left speaker, and as the ball bounces and hits the right side a boom of a different timbre echoes out of the right speaker. As the ball rotates, you notice that the bouncing pattern seems to be random and the shadow is transparent. You move the two-button mouse to the top of the screen to pull down the picture; as the ball continues to boom and bounce randomly, a solid blue background comes smoothly down like power windows, and you notice that the bouncing and booming continue without interruption. What you can't see is that while all this is going on, the 68000 CPU is running at just about 9 percent of its rated power.

You have just had your first encounter with the Amiga computer.

AMIGA FACTS

There has been so much hype about Commodore's Amiga, one tends to forget there are facts, but here are some of the more important ones:

Price: $1,295 list, complete with built-in 3½-inch disk drive, keyboard, mouse, and 256K RAM. Though you can hook the Amiga up to a regular color or black-and-white monitor (or RF modulator and TV set), an Amiga with high resolution RGB monitor (recommended) goes for $1,750 list. (RGB stands for red-green-blue; an RGB monitor has separate outputs for each color.)

Processor: The Motorola 68000 main processor is a 32 bit internal CPU with 16 bit inputs and outputs, and runs at over 7 MHz. This is the same processor used in the Apple Macintosh and Atari ST series. The Amiga also has three very important custom Very Large Scale Integration chips (see below).

Memory: 256K RAM user-expandable to 512K internal (upgrade list price $195) and over 8 Megabytes externally. The CPU does not need to swap banks to address the full memory range, thus speeding up operations.

Custom chips: What differentiates the Amiga from any other personal computer sold so far is three custom Very Large Scale Integration chips: *Agnes, Denise,* and *Paula.* Agnes has the hardware for up to 25 channels of Direct Memory Access, which allows for fetching data directly from memory without having to first go through the CPU. Agnes also contains the custom *bit-blitter* which is used for high speed data transfer, and *Copper*—a high speed (twice the speed of the 68000 for some tasks) co-processor that takes over chores deemed too unchallenging for the 68000.

Denise is primarily the video composite and graphics chip; Paula contains the disk controller, system interrupt generators, serial port, and four individual sound generators (which are low noise companding 8 bit D/A converters with independently programmable volume and sampling rate). Yes—digital sampling built into the Amiga just by adding an A/D converter. (No, it won't sample out of the box; but you don't need anything fancy.) There is also a built-in speech synthesizer and text-to-phoneme converter. Unlike the Mac which uses over half of the 68000 processor's time doing software tricks to produce up to four voices from the single sound generator, the Amiga, once started, can play four independent voices from its hardware sound generators into individual *stereo* outputs with no (I mean zero) time taken from the 68000.

Disk drives: There's a 3½-inch 880K disk drive built-in and you can daisy-chain up to three more 3½-inch *or* 5¼-inch double-sided floppy disk drives, for up to 3,520K of floppy disk storage. The Direct Memory Access driven disk operating system can read over 5.6K bytes of data in a single revolution because of the full track read/write disk operating system—so what does this mean to musicians? Probably it means if you had a long sequence on a disk, the Amiga could retrieve data off the disk in larger chunks.

Emulation: It is possible to reconfigure the disk operating system to read/write Apple II disks and read/write 320/360K IBM PC formatted disks. For those who say there's no software, Commodore Amiga has a 5¼-inch floppy disk drive and companion *software* that reads, writes, copies, and runs IBM PC disks onto 3½-inch or 5¼-inch floppies (see sidebar). It is also theoretically possible to emulate Apple II or C-64 operation with this kind of software based emulator.

Operating system: The Amiga (for now) has very little in machine ROM; just enough to wake up, do a test or two, play a little music, fill the screen with a graphic instructing you "to please put in the Kickstart disk," and then read the disk into 192K of "ROM" space. This writeable con-

Amiga Facts at a Glance

$1,295 list price ($1,750 with Commodore model 1080 RGB Monitor)
68000 32/16 bit CPU running at over 7 MHz
Three custom VLSI chips
256K RAM expandable to 512K with Commodore 1050 expansion cartridge ($195 user installable)
3½-inch 880K built-in disk drive
4,096 colors maximum
640 × 400 dots maximum resolution displaying 16 colors
Two button mouse
Serial port (also used for MIDI in conjunction with adapter)
Parallel Port (also used for printer)
Two controller ports
89 key detachable keyboard with calculator pad
Simultaneous composite video and RGB outputs
Left and right stereo audio outputs
Four hardware sound generators
True 68000 expansion port
Multi-plane, sprite and graphics generators
External disk drives: Model 1010 3½-inch disk drive ($295) and Model 1020 5¼-inch disk drive ($395).

—David Karr and Peggy Herrington

Electronic musician and former college teacher ***David Karr*** *works extensively with video and audio, which was enough incentive for him to buy an Amiga the evening it appeared on his local dealer's shelf. He is currently building Thunder Mill, a video/audio live-in studio in the Pennsylvania countryside.*

trol store, actually a rather complex hardware card, makes the operating system flexible and updateable (and more expensive). At the same time, the lack of a finalized operating system is distressing to many software developers, who lose time and money re-writing code to reflect the changes. Unlike the Atari "Jackintosh," the operating system does not reside in program RAM, so the Amiga's entire 256K (or 512K) of memory is available for the program. Once loaded, the protected RAM acts as ROM and survives both software crashes and even system resets until the machine is firmly shut off.

Graphics: Here we're talking high-resolution graphics producing 32 colors (or 4,096 colors on screen simultaneously in a special mode) in a 320 × 400 interlaced (or 200 in non-interlaced) display... or 16 colors in a 640 × 400 interlaced (or 200 non-interlaced) display.

User interface: Two-button opto-mechanical mouse. The left button selects functions in a similar fashion to the Mac; the right button is usually used to make the menu windows appear but can be programmed to do anything. The user interface is of the icons-and-menus school, with windowing options and some other "gadgets" thrown in for good measure. For those with rodent phobias, or an attachment to typewriter keyboards, Amiga also provides their multi-window CLI (command line interface) where you can type in commands in English-like text.

Ports: First there's a fully programmable serial port used for modems, other serial devices, and MIDI (in conjunction with a simple hardware interface consisting of an optocoupler, three transistors, and a few resistors—no crystal or UART). Incidentally, the Amiga can internally generate the 31,250 bits per second data pulses that are necessary for MIDI. A fully programmable parallel port connects to color printers and other parallel peripherals; the disk drive port is for daisy-chaining external drives.

Expansion port: The entire 68000 bus (not just a parallel port) is available for extra RAM, additional disk drives (floppy and hard), peripherals such as the Frame Grabber, co-processors, and so on. Finally, there are two re-configurable controller ports for mice (eek!), light pens (write with The Force, Luke), joysticks (oh baby), paddles, (oh yes!!) or (... say it!) custom controllers (keyboards or other electrical devices).

Keyboard: The Amiga has an 89 key detachable keyboard with calculator pad, function keys, and cursor keys. For maximum use of the keyboard in non-text applications, both key-down and key-up signals are available for use.

Outputs: Simultaneous composite video and analog or digital RGB outputs are available. The Genlock option is a synchronizing board that will sync the Amiga graphics to any incoming video signal from a color camera, VCR, or video output from broadcast TV or cable. Anywhere the screen is color 0 (blue) the video from the input will come through. For you video folks out there, this is like a digital chroma-key. If you had a moving square of color 0, the video would show through anywhere the square moved. This makes titling and graphics for video possible, and with data-compatible paint software (such as Electronic Arts' Deluxe Paint) the Amiga becomes a budget video paintbox. The Genlock board also includes a stereo mixer to combine the TV or VCR stereo audio with stereo audio from the Amiga. Genlock is unique to Amiga and is slated to be $250 retail. Audio outputs include ports for left and right stereo channels from the four individual sound generators.

THE SOUND GENERATORS

As mentioned above, the sound generator is actually four independent eight-bit Direct Memory Access-driven D/A converters. This is the audio equivalent of bit-mapped graphics. The waveform is built-in memory; the custom chips are directed to the beginning memory location and read out the data. This data is converted into four channels of sounds appearing at the stereo audio outputs. All this happens according to commands

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in the software and is independent of the 68000, which is free to do anything or nothing at all. The audio channels can be linked together for amplitude modulation, frequency modulation, or both simultaneously.

Trigonometric functions can create periodic waveforms (sine, square, triangle, etc.), or you can sample with a maximum speed of 28.867 kHz (yes, just like a keyboard instrument; see sidebar). In this case, the amplitude of the waveform is measured by an accessory A to D converter at a specific rate, resulting in a table of numbers that can be stored in digital memory. On playback, those numbers are spit out in the desired order (usually in the order in which they went into the machine, but you can always do tricks like read the data out backwards for backwards effects) and at the desired rate (usually the same as the original sampling rate, unless you want to transpose the sound). These numbers are essentially points on an imaginary graph which are re-connected by a digital to analog converter; this changes the points back into a stair-step analog waveform, and filters the stair-step into a curve that more closely approximates the original curve of the sampled wave. How close the approximated wave is to the original is directly, but not entirely, proportional to the number of samples taken and stored. The "out of the box" Amiga cannot sample sounds, but I was impressed by most of the 18 pre-recorded demo samples.

Volume provides 65 steps of level control over each of the four individual volume registers; the actual waveforms stored in memory are not affected.

The sampling period determines the pitch of the four sound generators by specifying the number of system clock ticks (timing intervals that should elapse) between each sample. There is a period register for each sound channel, each ranging from 124 to 65,535 ticks per sample. A low period value corresponds to a higher frequency and a high period value corresponds to a low frequency.

Combining the waveform tables together provides different sounds, and with the right software, it is possible to edit the waveforms by numbers or on the screen with the mouse or light pen. Joining tones is made easy thanks to backup registers (which hold the addresses and lengths of the samples) and the interrupt timing; just write the location and length registers, start the audio output, and re-write the register in preparation for the next waveform to be joined to the first. Amplitude and frequency modulation of the waveform by any of the others is easily accomplished.

Write Now.

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LICENSE TO STEAL

How a sound is heard through the stereo outputs is even more interesting. Like almost everything else on the Amiga, the sound control system is efficient and well thought out. The hardware controlling the four "voices" can be directed to release a sound to a specified (or non-specific) channel according to A) the amount of sounds that are requested to sound with respect to the number of voices sounding and B) the priorities set for these sounds.

For example, as with any four voice synthesizer, only four sounds can be heard through the output channels at once. With some synths, as you add a fifth note, either it won't sound or one of the voice channels will be "stolen" from one of the notes already sounding. On some systems this is a next-key-down priority, and on some it is random. With the Amiga, you can allocate "precedence" to any or all of the sounds so that they can't be stolen by another task (or they can go quietly, officer, if that's what you wish) by storing a number into a register. The channel allocation precedences can range from unstoppable (127; nothing will keep the sound from its appointed task), through emergencies (90-100), speech (75), music (50 to -50), sound effects (-70 to 0), background sounds (-100 to -80) all the way to silence (-128). This really makes the four voices in the Amiga function like so much more. You can instruct the machine to steal a channel from a sound that has a short decay, instead of one that is sounding concurrently but is supposed to have a long decay, and should thus fade out slowly. You can have annunciators that make sounds you need to hear take precedence over background sounds or music, so that any announcements will always be heard. You can also assign precedence to right and left stereo channels in the same way (i.e. some sounds you might always want to come out of the left channel, and others you might not care where they come out as long as they are heard). If you don't specify a preference, the system will choose channel allocation by itself—the flexibility is there only if you want to use it.

As with most samplers, the quality of the sample depends a lot more on the skill of the humans doing the sampling than on the computer (remember, it's sophisticated software that makes the Emulator II's eight bits sound like a lot more). There are many tricks you can play to improve sampling quality, such as recording only loud sounds (thus minimizing quantizing error) and regulating the volume elsewhere in the computer rather than trying to record samples with full dynamic range. Of course, you can't beat the laws of physics—highest fidelity means using lots of memory, so compromises have to be made of an artistic as well as technical nature. These include what sample rate to use, the desired sample rate, and so on.

MY COMPUTER CAN CRASH YOUR COMPUTER

The inevitable question is how does the Amiga compare with the Mac and Atari 520ST. The inevitable answer is it all depends on what you want. All three computers are technologically sophisticated, certainly more so than older eight or 16 bit systems. They all offer quality graphics (the Mac in high-resolution black and white, with square pixels for sharper printing). All three machines, being based on the same processor and using the same currently available technology (a 68000 is a 68000 no matter what box it's in), and are of similar ancestry and quality. As usual, it is the little things, the personal desires, that compel the purchase of one machine over another.

IBM Meets the Emulator

Unlike other emulators which usually have an additional on-board processor of the alien type and re-reads/writes its commands and addresses, the Amiga Transformer does not have an 8086 or any other processors, but is software-based. Because of the Amiga's speed and multi-tasking, the Transformer emulates IBM hardware and not the BIOS or DOS. The Transformer receives the instructions through PC-DOS or MS-DOS slated for the 8086 and makes the proper changes in the addresses and commands so that the 68000 can do the task that was to be done by the ghost 8086. The Transformer can run standard, unmodified, copy-protected versions of the software without breaking the copy protection by reacting to the commands in the same manner as the IBM hardware would. Price for the package is projected at $99 for the Transformer software and $350 for the 5¼-inch IBM type drive (though you can use a existing drive if you have one).

When it comes to MIDI, Atari has a MIDI port built right in which certainly makes it musically-useful right out of the box. With the Mac and the Amiga, you need an interface to make the serial port signal MIDI-compatible (about $50 in the case of the Amiga).

Though you can do sampling on the Atari and Mac, as with any sampler you have to do tricks to get a decent sounding signal. Overall, I feel that the Amiga is more optimized for sampling if for no other reason than because the four voices can be played and manipulated while the processor is free to do other tasks.

When it comes to sound, the Atari chip (GI) is more of a sound effects chip (the legendary "Amy" sound chip never made it to market). With the Amiga, you just put in a disk and you can play a real synthesizer with the Amiga keyboard (which, interestingly enough, was designed as a typewriter keyboard on which you could also play music—check the music key assignments, for example).

Another advantage of the Amiga is that its sound generators are completely poly-timbral and polyphonic with note precedence. This means the Amiga can

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serve as a mini-composing machine with no accessories other than the proper software (although hooking up external instruments via MIDI will let you do correspondingly more).

The Mac is already established; the low price of Atari's computers will probably make them the Commodore-64 of the late '80s, but for sheer horsepower the Amiga is untouched. The entry price of the Amiga is more than an Atari, but you are getting more right out of the box. The Amiga costs less than a Mac, but the Mac has a lot more support right now. Emotionally speaking, though, the Amiga is my all-time favorite for a personal computer.

> *"...the Amiga can serve as a mini-composing machine with no accessories other than the proper software"*

LOOKING FOR THE LONE RANGER...

Future Amiga updates will in theory be upwardly compatible with existing soft-

Sampling Basics and the Amiga

In order to properly evaluate the Amiga's sampling capabilities, let's look at digital sampling basics and what factors influence sound quality.

Fig. 1 shows a sine wave; note that the curve is completely smooth and continuous. Theoretically, the wave consists of an infinite number of points. This smooth curve is characteristic of an *analog* system.

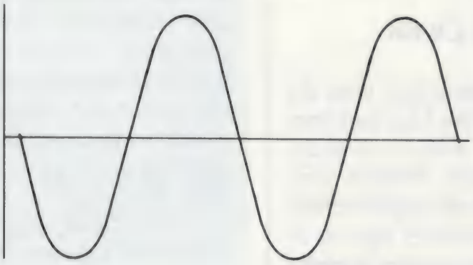

Fig. 1 *Analog sine wave*

A computer can manipulate only a finite number of different values. Therefore, to store a sine wave in memory, the computer must take a series of "snapshots" (samples) of the signal amplitude (this is analogous to the way film breaks down a continuous video event into a series of frames). The sample is held during the period of time between snapshots, thus producing a sine wave consisting of a finite series of discrete values (**Fig. 2**).

If we sample the sine wave less often (thus lowering the *sampling rate*) we would end up with the waveform in **Fig. 3**, which is clearly much less like a sine wave than the one in **Fig. 2**. We can conclude that you will not get an accurate representation of the wave unless samples are taken quite a few times during each wave cycle. The more complex the wave, the more often you will need to sample it in order to properly represent its waveshape; and since more complex waveforms are associated with richer, more interesting sounds, fast sampling rates are vital for musical applications.

There is some controversy over how fast a sampling rate is sufficient. Conventional wisdom says that twice the highest frequency heard by humans should be enough (40 kHz sampling rate), but some high-end systems are now offering a 100 kHz sampling rate. The reason why everyone doesn't just use a real high sampling rate is that it takes a lot of memory to store all those samples. 512K of memory, at a 100 kHz sampling rate, would fill up in just over five seconds if the data was stored as 8-bit words. The solutions so far have involved variable sampling rates (use lower rates on signals that don't require as much resolution), companding D/A and A/D converters to provide the digital equivalent of dynamic range expansion, and unusual software techniques to help compress data.

Where does the Amiga fit in all of this? First of all, without added hardware the Amiga can only play back previously recorded and digitized sounds—it cannot by itself make a digital recording. As to sampling quality, the numbers tell the story. The Amiga plays back companded 8-bit samples at a maximum rate of 28,867 samples per second (the Macintosh's specs are very similar). For comparison, the Ensoniq Mirage is also an 8-bit machine with a maximum sampling rate of 33 kHz. This kind of performance places these devices towards the lower end of the professional spectrum, with monumentally expensive 16-bit machines such as the Fairlight Series III and Synclavier holding down the high end.

—*Tom Jeffries*

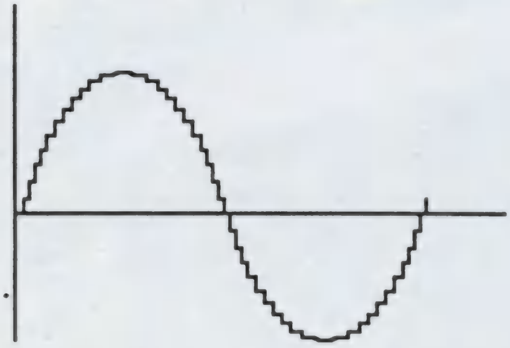

Fig. 2 *Digitized sine wave*

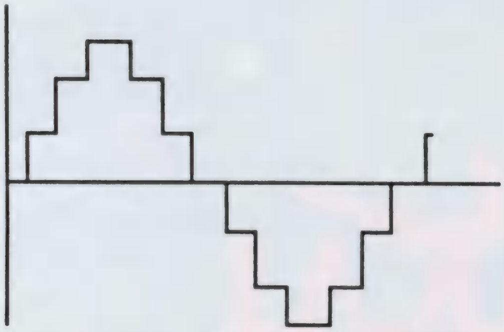

Fig. 3 *Sine wave digitized at lower resolution and sampling rate*

ware and peripherals. Rumors of the 68020 microprocessor, new custom chips, 32 bit memory bus and ultra-high speed clocks (up to 25 MHz) are roaming about. While this is functionally impossible on the current Atari and Mac, it is a reality today for at least one hyper-involved Amiga owner out there.

"A MACHINE TO WATCH"

That's what everybody's saying. . . but forget about watching, start working with it. The sooner its functions and uses become clear, the sooner the software and peripherals will start to hit the stores. Only then will the smoke of hype clear sufficiently to see the true power of the Amiga.

Through sources that insist on remaining anonymous, I have found out that some of the Amiga software developers have placed Amiga software "on the back burner" for a while to see if the Amiga takes off or if Commodore is going to crash (reports of their death may be exaggerated; they seem to be selling a lot of 128s and, surprisingly, C-64s). Obviously, a major determining factor in whether or not a new computer flies or not is the amount of available software (unless you're IBM). Though no software company will admit to doing it, a shyness to commit to developing software for a new machine will contribute to the slowness of public acceptance. But the big guys had better be careful. I suspect that small operations will take up the Amiga's software slack, and a few of these might become big guys themselves (remember, Apple started out as a garage operation).

> *". . . not one ad mentions that this computer is, among other things, fun"*

Remember back when the Mac was introduced . . . the major complaint was not only a lack of software, but the widely publicized closed architecture as well. Over two years later, a good variety of software is finally out for the Mac, yet the insides are still firmly shut. Despite the Amiga's open architecture, true multi-tasking, and stunning graphics/audio capabilities, people are still wondering whether or not the Amiga is going to catch on. Well, people also wondered whether the Mac would catch on when it was introduced, and look what happened.

Maybe Commodore has not gotten the message across; not one ad mentions that this computer is, among other things, fun. I doubt whether the people responsible for selling the machine fully understand what this computer is all about. Getting answers to inquiries about the Amiga were arduous, and most were provided by software and hardware engineers who work on, or in some cases designed, the machine. My extreme thanks go to Bob Pariseau from Amiga for his help, and to unofficial contacts who provided much more information than Commodore's promo people. Some other people took time to talk about the Amiga, including Bob Hoover, director of product development for Mimetics and designer of the Amiga MIDI interface for Commodore.

Flexibility and the ability to upgrade are two factors that don't become evident right away in a new machine. Knowing in advance that it can do something and learning its attributes takes more imagination than just watching, or hearing, something happen. That's why until more software and hardware peripherals actually make it to the stores, the power of the Amiga will sound like a lot of PR hype. But the power *is* there . . . and it's waiting.

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A computer is nothing without software, but software for the Amiga has been slow in coming. Still, many products are nearing completion; here is a report on various works-in-progress.

Amiga: The Software Behind the Hardware

BY PEGGY HERRINGTON

If you're considering a computer, take a long, careful look. But be prepared to do more than that when you look into Commodore's Amiga—be prepared to stop, look and *listen.* In a bold break from traditional electronic synthesis, this computer makes sound internally with waveform and envelope generation using four independent sound sources, each with its own volume control, nine-octave range and 20 to 7,000 Hz frequency response. Other features include stereo outputs and low distortion (under 1 percent). What's more, the Amiga is not limited to internally generated sound; real world sounds can be sampled with the Amiga's four built-in variable rate digital-to-analog converters and two low-pass filters.

Other articles in this issue tell much about the machine's features from a nuts and bolts standpoint, so we won't repeat that sort of information here. What we will do is go over what some of these features mean to musicians, and some of the capabilities we can expect from present and anticipated Amiga programs from several manufacturers.

AMIGA MUSIC BASICS

The Amiga uses a *multi-tasking*-oriented design, which means that several separate computer programs can be active simultaneously on one Amiga, each visible on the screen in a defineable area called a "window," with each program using everything the Amiga has to offer—including the sound circuitry—*all at the same time.* And that means that with appropriate software and enough memory, it is theoretically possible to listen to a sequence or score while writing comments on a word processor as the Amiga sorts a data base, prints a report and patiently awaits your next move in a strategy game, all with minimal slowing of the central processor.

The Amiga also offers digital sampling; one way to approach this concept is to think of the sound generators as four individual tape recorders. Instead of using magnetic tape, these recorders play sounds stored in computer memory. While sampling keyboards are now becoming plentiful, the Amiga is the first personal computer to incorporate sampling as an integral part of the machine. Because multitonal sounds can be digitized on the Amiga within a single sample, they can be played back by a single generator. As one example of how to use this, by sampling separate major, minor and diminished chords as they are played on another instrument or from a record or tape, an entire multi-part musical accompaniment can be produced by one Amiga sound generator simply by sequencing one chord after another. This leaves the other three generators free for rhythm, embellishments or special effects. Even if sampling isn't for you, the technology is important because it provides the means for building libraries of complex sounds that can be in music as well as other programs.

Another feature with musical and educational possibilities is the Amiga's unique resident speech synthesizers. Modeled on analyses of actual male and female voices, each of these can convert text to speech from the computer keyboard or a program and can essentially read out loud. The diction is understandable despite being heavily inflected and because their pitch is changeable, they can also sing. They can be accompanied by music generated internally or from MIDIed synths (however what I've heard so far wouldn't worry Herbie Hancock). Something that's more musically satisfying (not to mention fun) is sampling a real voice saying something like "Doo" or "Dah" and changing its pitch by playing it up and down the scale on a keyboard. Playing several slightly out-of-phase samples together sounds like a chorus.

Of course, any synthetic sound generator or sampler has its strengths and weaknesses; but thanks to the direction of a musician who knows a few of the Amiga's tricks, I have found the overall quality of its sound to be surprisingly clean. Now let's proceed to the programs.

> *"Music and computers had been flirting for nearly 50 years when MIDI finally got them to the altar"*

AMIGA MUSIC PRODUCTS

Music and computers had been flirting for nearly 50 years when MIDI finally got them to the altar. Now with three computers that have the potential to be MIDI giants (the Mac, the Atari 520ST and the Amiga), we can expect more and more software that brings the vast (and still growing) array of synthesizers, samplers, drum machines and various other electronic devices under MIDI control.

I talked at length with several Amiga program developers at recent trade shows, where I saw working prototypes of Amiga hardware and software in various stages of development. Some of the packages feature MIDI, while others access only the internal machine sounds. Some use both. With the substantial caveat that it ain't for sure until it's on the shelf, here's what will be supposedly coming our way in the near future.

MIMETICS

Mimetics, a relatively new company with a pretty impressive track record, plans a series of music programs and devices for the Amiga (many of which were at least partially operational when I saw them) that work together in one environment, but from which you can select and design

---

***Peggy Herrington** frequently writes about sound synthesis and telecommunications for computer magazines. She is an* AmigaWorld *contributing editor and her column "Sound Advice" appears regularly in* Info *magazine. She plays keyboards in her home MIDI studio, classical piano in her living room, and believes that musical expression is an end unto itself.*

your own individualized music studio. It's a modular system, where you add programs as you would add keyboards and drum machines to a MIDI set-up. These products are intended to let you do everything from studying theory and ear-training at your own pace on the Amiga's sound system to arranging and editing multi-track compositions on MIDIed synths and drum machines—with or without sampled and internally generated sound.

SoundScape ($89), which functions as both a music operating system on the Amiga and a stand-alone recording studio, is the only program in this series that you *must* have—sort of the software equivalent of a motherboard. It features a 16 polyphonic channel MIDI sequencer with an unlimited number of tracks and a simple cut and paste editor that allows detailed editing of any event recorded on the system. While in SoundScape's main display screen, you choose the instruments for recording or playback. These include the internal sound synthesizer, piano-style keyboards, MIDI input and output, pitch followers, the Amiga typewriter-style keyboard and any of the display screens from other programs that provide note information (see below).

A Mimetics sampling device (projected retail under $100) that's about the size of a pack of cigarettes records real world sounds that can then be used as musical voices by system instruments. The sampling software, like that of the other programs in this series, is integrated into SoundScape when present. Sound editing can be done intuitively—by ear—or with the aid of more sophisticated software (available separately) that displays sound analysis and synthesis parameters in detail.

SoundScape's *match mode*, in conjunction with independent pitch followers, digitizes and records monophonic sound input. Its primary purpose is for music education, where a student plays an instrument or sings into the pitch follower microphone and tries to match prerecorded music played by the system. The music continues to sound at the tempo the student selects (usually a slow tempo at first) as long as the notes are correctly played. Upon detecting a wrong note, program operation waits until the correct note is played, whereupon the program automatically resumes.

Using match mode with one of the Mimetics display screens, the student can see which note was missed. A variety of these screens (some come with SoundScape while others are supplied from separate programs in the series) display music and performance information. Examples include standard notation that tracks the music, fingerings for a variety of instruments, chord names, transposition functions and note files with scale progressions, a piano keyboard with recorded musical tracks indicated and, of course, brilliant dancing graphic displays. Many of these screens provide bi-directional music input—instead of pressing the key you want to play (or record) on a keyboard, you can point to it on the screen with the computer's mouse.

Music theory, ear-training and musicianship programs are being designed and programmed by Mimetics for integration in SoundScape, ranging from self-paced home applications to an environment development system for instructors who have developed a particular approach to music education (or would like to). Just imagine the advantages—not to mention the blessed silence—of a music school studio with all the students studying or composing at once, in the same room, each listening to his or her music on headphones while the instructor monitors them individually from a centralized system by switching from one to another. Each student's progress or trouble areas could be recorded automatically by the computer, and with Amiga's multi-tasking talent they could even "talk" to each other by typing messages on the computer keyboard.

CHERRY LANE TECHNOLOGIES

A relatively new branch of an established music publishing house, Cherry Lane Technologies, is putting together a group of products for the Amiga that includes both integrated and free-standing products, some of which were designed by IVL Technologies Ltd., of Victoria, B.C.

Concertcraft ($49) was developed jointly by Cherry Lane with Carnegie-Mellon University. It uses "artificial intelligence" and speech recognition techniques to implement a complex concept that is simplicity itself to use: you play the melody and the accompaniment follows you, both dynamically and in tempo. Allegro or Rubato, ppp or FFF, it sticks with you. The lead line for your song (chosen from several four- and five-part prerecorded middle-of-the-road tunes provided on the program disk) is displayed on a colorful Amiga screen in standard music notation. You don't have to be a sight-reading maestro because pattern (as opposed to exact) matching is used to determine if the keys you press on the keyboard include a passing mistake or deviate from the notation sufficiently to warrant stopping the accompaniment. If that happens, the computer will wait until you start playing again a bar or two later (or take it from the top) and catch up with you. This program also works with Pitchrider.

Concertcraft will work either with or without MIDI, but in order to use it you'll need either Cherry Lane's four-octave piano-style keyboard ($99) to access the Amiga's internal sound circuitry, or their Amiga MIDI interface ($49) and, of course, a MIDI synthesizer. (It works great with Casio's CZ-101.)

Pitchrider, which was developed by IVL, uses the Amiga to digitize a monophonic sound source and separate the fundamental pitch—no easy task because of the presence of harmonics. It then sends that pitch information to an external synthesizer. This is a terrific way to practice a flute, for example, because you can listen to and study what you played and figure out which parts of a piece of music need work.

Musicraft ($49) was initially to be bundled with the Amiga, but was not finished in time. So, an abbreviated version (along with Graficraft and Textcraft) went to many Amiga dealers with their first hardware order. Musicraft is an attractive little program that probably won't wow professional musicians but is really fun to use. With it, you can enter music with the mouse or the typewriter-style keyboard, see it displayed in standard music notation, and get acquainted with the internal sound capabilities of the machine. Included are both generated and sampled sounds, some of which are very complex and must be heard in stereo to be believed.

Amiga Texture ($399) is, as you may suspect from the price, an elaborate product geared for more professional applications. Though still in the initial stages of development at presstime, it promises to be graphically-oriented (although it does not incorporate standard music notation) and includes, among other things, an extensive music sequencer. Texture makes use of the Amiga's ability to print graphic displays and text on video tape and coordinate sound and music with external video sources such as VCRs.

Also under development by Cherry Lane is a standard music notation package that will print sheet music with a dot-matrix or ink jet printer or plotter, and voicing programs for select Casio and Yamaha synths.

ACTIVISION, INC.

One of the largest and most aggressive

publishers of software for several brands of computers, Activision produced the first programs on the market for the Amiga, a series of four adventure games with astounding graphics and sound effects.

The *Amiga Music Studio* (also available for the Atari 520ST) is more for educational or amateur than professional use, although it implements MIDI. In one "mode" of operation, music is entered by selecting notes, rests, etc. and placing them on a grand staff on the screen with the Amiga mouse. In the other mode, these standard music symbols are replaced by less traditional indicators for beginners; durations are indicated by blocks representing relative periods of time and timbres by various colors. The interesting and educational aspect of this program is that music entered in one mode can be easily and quickly displayed in the other.

ELECTRONIC ARTS

This leading producer of computer software is getting into the Amiga in a big way with an integrated series of programs that seem to have great popular appeal. One of them, *Deluxe Paint Construction Set* ($99) is actually available now and allows the computer artist full control of the machine's 4,096 dazzling colors, graphics, and animation abilities. *Deluxe Video Construction Set* ($99) promises to do the same thing for people wanting to use the Amiga to enhance video tape by adding animated graphics and text.

Deluxe Music Construction Set ($99) has been kept very much under wraps to date and probably won't be available until later this year. Electronic Arts says, however, that it will do for Amiga musicians what Deluxe Paint and Deluxe Video do for Amiga artists, offering music composition using MIDIed equipment and the machine's internal sound. Until we can determine the accuracy of this claim, we can get started with the *Instant Music* program (which should be available soon). I had lots of fun playing with it at a trade show, though it is obviously not designed for the serious musician. Using various musical timbres and accompaniments provided for the Amiga from instructions in the program, I played lead lines by rolling the computer's mouse device on a desktop. Colorful graphics danced and undulated along with the music providing a kind of coordinated light show on the screen, and by pushing a button or two, I could alter the tempo or prevent nonharmonic tones from sounding. Music "composed" in this manner with Instant Music can be saved to disk and used with the Deluxe Music Construction Set when it becomes available.

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D.C. AL FINE

Everybody knows it's not enough to build a better mousetrap, so it's interesting to note the technical basis for Commodore's advertising campaign openly challenging Apple and IBM. Lots of people credit Apple's success with their IIe to what is referred to in the biz as its open architecture. The Amiga is designed around the same premise: people not associated with Commodore are encouraged to develop hardware and software for it by being offered technical support, the free sharing of information, and by providing hardware access ports galore on the machine itself. Quite the opposite approach was taken by Apple with the Macintosh. And, Commodore's software-based IBM-PC emulator (the TransFormer) allows the Amiga to run IBM-PC programs. It requires the external Amiga 5.25-inch disk drive and program loading time is extended, but a hardware fix recently announced by Commodore claims to solve the problem. IBM-PC programs running on the Amiga that I have seen include Lotus 1-2-3 and Word Perfect.

Comparing the Amiga with other computers is not unlike comparing a fugue with a round. It has been recognized by industry experts as a machine the likes of which the world has never seen, and it's making all sorts of waves—sound waves included. For musicians, it has the potential for superb MIDI programs and quality synthesis at a reasonable price . . . with the added benefit of having the flexibility and power to manage our finances and help us with correspondence. Thanks to multi-tasking, this can even all happen at the same time. Yes, the Amiga is quite a synthesizer; but it will also serenade you as you write about it, then check your spelling.

For more information, contact your local Amiga dealer or these companies:

Activision, Inc. Box 7287 Mountain View, CA 94039 800/227-9759

Cherry Lane Technologies 110 Midland Avenue, Port Chester, NY 10573 212/824-7711

Electronic Arts 2755 Campus Drive, San Mateo, CA 94403 415/571-7171

Mimetics, Inc. P.O. Box 60238 Station A, Palo Alto, CA 94306 408/741-0117 EM

There's more to the Amiga than music. . . has the age of affordable, high quality computer graphics finally arrived?

Video with the Amiga

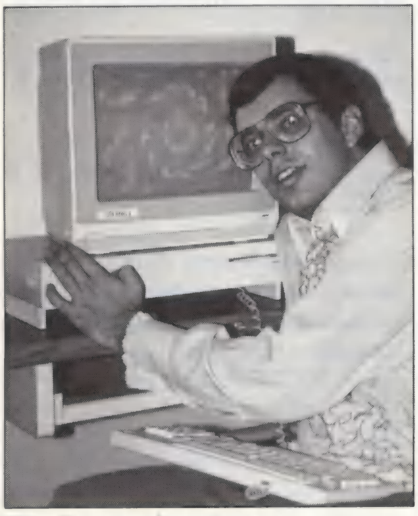
BY DON SLEPIAN

I have returned, for the third time, to the research arm of the phone company. This time I am producing computer music and video graphics to enhance the I/O channels of a supercomputer, and as always, the less said the better.

As I line up the computers in my playpen, to my left there's the MassComp. . . far and away the best graphics machine here, as befits a $140,000 mainframe in the company of micros. In front of me is an Amiga, fresh out of the box. To my right is a very embarrassed fully-loaded IBM AT, and in the corner is a totally indifferent and serene Apple IIe. The Mac is hiding under the table.

The Amiga is like a full-color Mac at half the price. In crunching numbers it performs like the IBM AT, and I feel its sound and graphics capabilities leave the AT far behind. To match the Amiga's performance, I would need to add a Number Nine "Revolution" graphics board, MIDI interface, and small synthesizer to the AT. This system would cost close to $10,000 and be far more difficult to use than the Amiga.

Don Slepian has been doing electronic music since 1970, and computer graphics and video since 1976; he has twice been sponsored by the French Ministry of Culture to perform live video synthesis in Paris and La Rochelle, and has given performances in New York and Philadelphia as well. He has several critically acclaimed albums and tapes available, and frequently performs live.



Don Slepian with an Amiga

Owning the Amiga today is like owning a turbo-charged sports car in 1850. All the roads (software) are for horses, and outside your own carefully flattened and graded backyard (the existing Amiga software) there's nowhere you can take it out of first gear. You could always hitch a buggy to the rear bumper and drive ten miles an hour behind the other horses (i.e. run MS-DOS programs in the Amiga's IBM PC emulation mode), but without good, smooth roads your iron horse is nothing but potential. Just as the Pony Express—through dedicated optimization of horse technology—could be faster than today's airmail, the nearly decade-old Apple II family of computers are, at the time of this writing, far more functional and useful than the Amiga.

SOFTWARE

The Amiga must have a supportive software environment, like that enjoyed by the Apple II, Commodore C-64, or increasingly, the IBM PC and Apple Macintosh, to be valuable. If there was CEEMAC[1] for the Amiga, I'd buy one so fast my VISA card would melt.

The Amiga is a powerful and unusual graphic environment; its true power is revealed only in the Amiga Hardware Manual.[2] This machine gives you Mac resolution (640 × 400) with 16 displayed colors. Its low-res mode (320 × 400) is far better than the Apple II's high-res, with 32 simultaneously displayed colors compared to the Apple's six. The Amiga's display co-processor allows you to change both color palette and resolution many times at arbitrary locations within a single screen. There are six "levels of imagery" or screens. Unlike the Apple II's screens, which you toggle between and view one at a time, the Amiga's screens are all simultaneously displayable and establish depth by object priority. For example, objects on screen 3 could be set so that when they move, they cover objects on screens 4, 5, and 6, and hide behind objects on screens 1 and 2. Like the Commodore C-64, you have a family of cute little sprites with the ability to detect collisions (or love taps) between them as they fly over the playfields. In the Amiga software, these are arrows or birds or pencils—all sorts of imaginative graphic objects that move independently of their background.

I did not find a dealer who would give me a price or delivery time on the Genlock option (I'm writing this in the final days of 1985). This option would allow you to slave the Amiga's video timing to an external video source, as if the Amiga were a synth whose keyboard was being controlled with MIDI. You could take your VCR's color camera and mix its video with graphics from the Amiga. This is no simple additive video mix; it is more like a computer-controlled key (switching at video rates). The external video takes the place of color 0 (usually background color, or it can be any shape) in the Amiga's display. Like in the movie *Tron,* you can leave the real world and jump inside a world of sprites and bit planes. And it's not just the background color that allows the video through; if you had a moving square of color 0, the video would show through anywhere the square moved. You could construct a new Garden of Eden, or be thrown onto the Game Grid to have the bits blasted out of you. . . your choice.

I'm looking through the Jan/Feb issue of *AmigaWorld* magazine. If you're considering the Amiga, you should call 800/258-5473 to order this back issue and your subscription. I see ads for "Deluxe Video Construction Set" by Electronic Arts,[3] "Aegis Animator" from Aegis Development,[4] and "Penmouse +" from Kurta Corporation.[5] They all appear to be good packages, but I'm looking for something a little different. I want the Amiga to sit in my MIDI network and behave like another MIDI synth, producing graphics and animations on cue from a track in my MIDI sequencer. I would construct a driver in the Amiga that would translate and link standard MIDI note commands to libraries of visuals created with any Amiga Graphics package. I could run any MIDI sequencer on my Apple, dedicate a MIDI channel to visual cues, and have the Amiga play animations in sync with the music.

The Amiga produces "compatible" NTSC video, which means you can view

Life Among the Genlocks and Frame Grabbers

Having played with prototypes of both the Genlock option and the frame grabber, I can say that Don's excitement is justified.

With the frame grabber, you can view the image in near real time (it takes three frames to digitize and display the signal), color or black and white. With a click of the mouse, you can store the frame temporarily to play with it or save it to disk (I've seen a disk hold at least four pictures and some software). While viewing live images, or if you store the image, you can manipulate it in many ways. Mouse movements change the image from black and white to color, or negative color and white and black. You can globally change the color areas (known as color maps) and the colors from the color palette that fills them, or even use the frame as the start of a picture that can be modified or redraw with a data compatible paint system (i.e. Electronic Arts Deluxe Paint). Yeah, they're hot.

—David Karr

it on a monitor and record it on your VCR. It does not meet NTSC's standard RS-170A, so it cannot be broadcast. I am hoping for an Amiga RS-170A broadcast adapter. That adapter and the MIDI "Visual Line" would transform the Amiga into the video synthesist's attainable, and affordable, dream machine.

I like the feature in Amiga DOS that identifies each diskette as it's inserted. The Amiga kickstart disk, which contains the operating system and must be loaded into the computer every time you turn it on, brought me back to the summer of '76 when I was toggling in the bootstrap loader of a Cromemco 8080 to coax some life out of the beast. The kickstart disk is a minor inconvenience; really, something as modern as the Amiga should have its loader, the "workbench," the word processor, the graphic demos, and Mahler's 5th Symphony resident in ROM. After all, the HP110 has the equivalent in business software in ROM, so how about giving us musicians and artists the executive treatment! Perhaps this could be an option or separate accessory for those of us with executive funds?

So, I like the Amiga, but it's not real useful to me yet. If the Genlock board works as claimed, I'll be won over.

I must mention one more item in closing: The Telecomp 1000 Computer Video Combiner.[6] This $400 box allows you to take any video camera that accepts external sync[7] and combine its video with the output of any microcomputer. The camera video is under full window control, so it can appear in any size or location on the screen.

Do go to your dealer and check out the Amiga. Insert the Electronic Arts disk and select the "Polyscope" option. Ask your salesperson to please dim the lights. Assume the full Lotus position and genlock your breathing. Inform the salesperson you must meditate on this important purchase decision, and stare directly at the center of the screen. This natural high has been my favorite use so far of the Amiga.

[1] Ceemac Products are available from Brooke Boering at Vagabondo Enterprises, 135 Stephen Road, Aptos, CA 95003. Tel. 408/662-0422. These are visual art packages that run on the Commodore C-64 and the Apple II family.

[2] Order the Hardware Manual from Commodore-Amiga, 1200 Wilson Drive, West Chester, PA 19380 or your local dealer.

[3] Check your local dealer or call Electronic Arts at 415/572-2787.

[4] Aegis Development Inc., 2210 Wilshire Blvd., Suite 277, Santa Monica, CA 90403.

[5] Kurta Corporation, 4610 S. 35th Street, Phoenix, AZ 85040. Tel. 602/276-5533.

[6] Available from Universal Video, 195 Bonhomme Street, Box 488, Hackensack, NJ 07602. Tel. 800/631-0867.

[7] Cameras that accept external sync are available everywhere, but the best prices I've seen are from Discount Video Warehouse, Box 36, Mount Prospect, IL 60056. Tel. 800/323-8148. The Panasonic WV-1500 monochrome camera was listed at $248, and the single-tube color JVC GXS-700U camera at $1,385. Check with them for current prices and lenses for these cameras. **EM**

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Paid Newsletter from E-mu Systems

THE EMULETTER

Issue Number 5 "One for the Whales. Five for the ugly suit." April 1986

User Tips

CRAIG ANDERTON

To maximize the dynamic range of the SP-12's velocity sensitivity feature: create the bulk of your piece with the velocity sensitivity off (Set Up feature 17). Keep your mix levels down 3-4 increments, then switch Velocity Sensitivity on to record the parts you want to accent dynamically. This will give you a piece with a broad dynamic range *and* give your buttons a rest.

E2 Disk Software Update Procedure

RILEY SMITH

DUAL DRIVE:

1) Boot up E2 with most recent version software (2.2 or 2.3).
2) Enter SPECIAL module and select Function 14 (Write Software).
3) Answer YES to question: *copy will erase memory, OK?*
4) Remove software disk from drive and replace with disk to be updated.
5) Press flashing ENTER button.
6) After update is complete, display will read: *Another Disk to Copy? Y/N*
7) If you do, insert next disk in drive #1 and press Yes; if not, press No.

E-II...Flash Tips

GERRY BASSERMANN

1) DE-ASSIGN VOICES

Always de-assign voices from their preset(s) when erasing them from a performance bank. There are two ways: a) erase the voices, and then go thru all presets and de-assign (Preset Definition #24) all regions that say 'UNDEFINED,' or b) write down the numbers of the voices to be erased—go thru and de-assign all of them first, and then erase all voices. WHY? Since LIBRARY files always search for the lowest-numbered available voice location when being brought into a performance bank (Preset Definition #11), new sounds will take over erased voice locations as well as their remaining keyboard assignments, and you'll be left with a confusing mess of ugly presets and nefarious messages such as "ILLEGAL ASSIGNMENT" and "READ YOUR EMULETTER." So don't forget to DE-ASSIGN.

2) MIDI □E-II

Another little thing about voice assignments: say you have a preset that has some portion(s) with no voices assigned, and you're controlling it thru MIDI from another keyboard with both instruments sounding. Chances are, some of the controllers' sounds will 'stick' (keep sounding) when they venture thru the non-assigned areas. Solution: sample a smidge of silence and assign it to those portions of the E-II preset. (Or, truncate an unused voice-or a copyback to nothing, and then assign it.)

3) ATTENTION SOUND DESIGNERS:

Cross-fade looping is here! It's a beautiful thing—but remember, this process needs a substantial voice file length to work properly. You can always truncate *after* X-fade looping successfully and win back some memory. Kind of like cutting hair—it's a one-way deal. So if you suspect that you'll need to X-fade loop, leave a lot of bytes and use more disks if necessary. You can always combine them later.

4) Some lo-tech advice: watch the red fuse-holder carefully while transporting the E-II. They spring out rather easily and most of you don't carry spares.

SP-12... Flash Tips

1) SAMPLE FEEDTHRU

The SP-12 does *not* pass the sound to the audio output during sampling. (This happens to be a very clever feature of the E-II and is simply not possible with SP-12.) What can be heard, however, is a strange little distortion of the sound. This is the sound of the computer successfully approximating the data. Solution: turn the MIX volume all the way down during sampling. After completion, exit the SAMPLE module, turn the volume up and listen to the results. If you need to listen to the sound during sampling, then you must monitor the source separately.

2) SMPTE

After striping a tape track with SMPTE time code (SET-UP #23 SPECIAL #14—the code begins to write as soon as you enter 14), you're ready to slave the SP-12 to the tape deck (SYNC #3) and lay a song on tape. However, if the SP-12 begins to run at the very beginning of the SMPTE (00:00:00:00), it will very likely miss the first beat. This is why it is important to establish a Start Point other than zero seconds. I always use 00:00:10:00 (ten seconds) but that's just because I have ten fingers. Using start points also allows you to stripe the whole tape *once* and use multiple start points for multiple songs.

3) CHANNEL ASSIGN

SET-UP #17 allows you to send any sound to any channel. The channels have different amounts of filtering that are fixed (channels 1 and 2 being most heavily filtered, 3 thru 6 becoming less and less so, 7 and 8 totally unfiltered—E-mu service department does provide information to purge all filters). Anyhow, what is especially important for the user to know, is that those channel assignments *are* programmable, and that they are stored as MIX information (there are eight mixes). So, it is possible to program channel assignments in the middle of a SONG, just as it is possible to program levels. The creative possibilities of this are endless.

4) SPECIAL 20—DECAY/TUNING RANGE

This latest feature provides three ranges (LO-MID-HI) of either decay or tuning for any RAM sound (this means over two octaves for a single sample!). What's important to remember is that the range affects playback as well as record mode. So if you've set a pitched sound to the LO range, and recorded some notes into a segment, and then change the range to HI to record some other higher pitches, the low notes already recorded will play back in the HI range (most likely with very wrong pitches). Solution: copy (SPECIAL #17) the sound to another location, and change the range there.

Over the past ten years, ambience has gone from something you add to a track to something that is part of a track—and Larry has some ideas about what all this means to musicians.

Ambient Thoughts

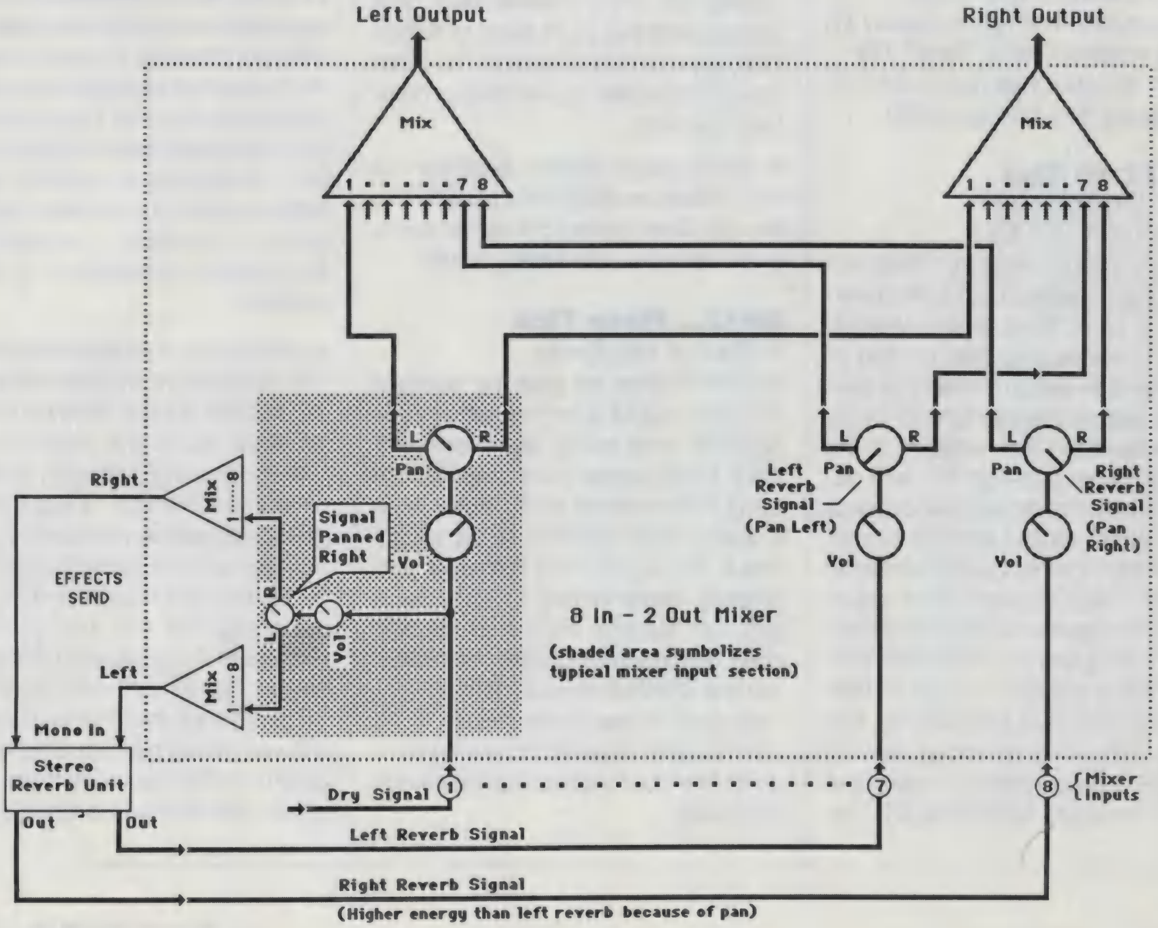
BY LARRY FAST

While many changes have occurred over the years in the world of musical electronics, some of the most important changes concern ambience. Since many readers have expressed an interest in the general subject of ambience, it seems like a good time to look back on techniques that were tried in the past, and how ambience technology has evolved over the past decade or so.

Ambience is an important part of the sound of my music, and I have used all types of reverberation devices. When I first started working extensively in the studio, the only real options for reverberation were live acoustic chambers, spring reverbs, and EMT plates. On the first Synergy album in 1975, I used a couple of the big EMT 140s and one of the smaller EMT 240 gold-foil plate echoes. These were just about the cleanest sounding reverberant chambers you could get your hands on at that time (short of booking time at some studio with one of the few, classic live-room chambers). For pre-echo, I would usually run the reverb's signal though a spare ¼-inch tape machine (recording at the record head and picking up from the playback head a fraction of a second later), and play with the variable speed control to set the appropriate amount of delay going into the chamber. The sends to the chambers were usually equalized to give a bit more sizzle to the top end, and sometimes I would detune the signal just a little using a 360 Systems Frequency Shifter in those pre-Harmonizer® days. The plate returns would be in stereo to add to the spatial quality.

One of my old favorite tricks for creating an extra degree of spatial control was to use AKG BX20E stereo spring reverbs. The unit had two independent mono in/mono out channels. I usually used the reverb send panpots so that if a dry signal was panned more or less to the left, the reverb send would go more or less to the right. Thus, the reverb image return would appear in the right channel and balance the sound in the left channel (see **Fig. 1**). This technique worked especially well with stereo paired sounds, such as stereo strings, since the cross panning produced a bigger sound.

The main reason that I used springs was because, at that time, they were cheaper and more readily available than other types of reverb—the plates were considered to be a premium. Sometimes I'd even send the spring returns back to the plates, which were mono in/stereo returns; I'd kick the plate with a mono signal and get a synthesized stereo sound back. Even though the springs did have a slightly "boingy" kind of sound, and the


Left Output
Right Output
Mix
1 . . . . . . 7 8
Mix
1 . . . . . . 7 8
Right
Mix 1......8
EFFECTS SEND
Left
Mix 1......8
Mono In
Stereo Reverb Unit
Out
Out
Signal Panned Right
L R
Pan
Vol
L R
Vol
L R
Pan
Left Reverb Signal (Pan Left)
Vol
L R
Pan
Right Reverb Signal (Pan Right)
Vol
8 In - 2 Out Mixer
(shaded area symbolizes typical mixer input section)
Dry Signal
1
7
8
Mixer Inputs
Left Reverb Signal
Right Reverb Signal
(Higher energy than left reverb because of pan)

tone quality wasn't even as good as we're used to from budget digital reverbs today, adding them in with the plate sound allowed me to expand the dimensionality just a little bit more. This is a technique that I still occasionally use.

One of the common questions about ambience is whether or not to print ambience on a track as you record, or to wait until mixdown. As usual, there is no one answer, but I have evolved some general practices over the years. When I first started out, I would never print any of the reverberant echoes on the multi-track, but would almost always print any kind of distinct delays (slap, doubling, etc.). Back then, you often had only one DDL in a studio, so you couldn't count on tying it up during the mix if you wanted it optimized for more than one track at a time. Echo chamber sound, on the other hand, was always left until the mixing stage.

> *"When I first started out, I would never print any of the reverberant echoes on multi-track"*

Of course, that was ten years ago and things have evolved. More recently, I've been playing with using longer release times, MIDI, and similar non-delay based processing to create additional ambient effects. In the past, I didn't consciously use synthesizer programming techniques to add ambience, but there would still be a hint of that kind of thinking in the sound patches. When the first polyphonic synthesizers came out, I often used precisely-specified release times to create spatial depth by setting the sound for a certain amount of ring-over. That in itself could become quite useable as a sort of pseudo-reverberation when used in conjunction with another sound that provided a dryer, more upfront transient, or otherwise distinctive attack.

Probably the biggest change that has happened over time has been the evolution away from mechanical reverberators, which are inherently limited by their design. When I got to play with the the first digital reverbs around 1978 (the EMT 250, and a smaller unit from Quad-8 that was quite noisy, but worked), they both had the ability to make many critical adjustments on the reverberant space being created. This changed the ball game a whole lot, to the point where I got bold enough to print some of the tighter reverberant spaces right on the multi-track as tracks were being recorded. With mechanical plates, you could only adjust decay times and change the equalization somewhat, but the overall quality of sound remained pretty similar. With electronic reverbs, there were subtleties that could be added to the sounds that encouraged the programming of distinctly different reverberant sounds for different synthesizer patches. In a way, a dream was realized in that the reverberant quality of the sound—which is to me every bit as important as the air and environment surrounding an acoustic instrument when it's miked—could now really be considered as part of the overall sound. With reverb effectively joining filter settings, envelopes, LFOs, and other synth parameters as part of the patch, I started printing tracks regularly with their own custom acoustic spaces. About the only reverb decisions that were held in abeyance until the mix involved big, long, sweeping types of reverb effects—the really deep, deep echoes. Anything that was sort of a near-field ambience, the equivalent of room sounds obtained when miking an instrument, would go down on tape.

The natural extension of all this is the MIDI controlled digital reverb, which presumes that the patch set up on the reverb device is something to be recalled every bit as much as a sound. This is light years away from the old set-and-forget type of approach which was standard in the days of mechanical reverberators. In fact, you can even use the MIDI continuous controllers (pitch bend, velocity, etc.) to affect the reverberant sound. Thus, reverb is now becoming a part of the basic fabric of the music by being able to respond to dynamics, note changes, and the musician's general performance.

These various changes have all concentrated more power in the hands of the musician than ever before. Now it is up to the musician, not the physical limitations of expensive mechanical devices, to decide on a particular reverb sound . . . so choose well, and have a good time enveloping your music in its own characteristic ambience. EM

__Larry Fast__ is one of the most respected synthesists in music today. In addition to his highly acclaimed work both in the studio and on the road with Peter Gabriel, Larry has recorded seven albums under the Synergy name, and done sessions for hit songs by such artists as Bonnie Tyler, Foreigner, and Hall & Oates. He also writes computer software and invents gizmos that make his equipment run smoother and more efficiently.

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I'm Thru With MIDI!

BY KIRK AUSTIN

MIDI is really a great help to the electronic music industry and to electronic musicians. Before MIDI, it was so difficult to connect instruments from different manufacturers together; now I can create really huge sounds by simply connecting my DX7, Ensoniq Mirage, and Roland JX8P together with MIDI cables. I love it! There's only one problem with my system, though . . . if I get one more synthesizer, I'm going to run into trouble because I just don't have enough MIDI output jacks.

By now, we've all been made aware of the reasons why it is not advisable to use the MIDI Thru jacks that are available on some synthesizers (if not, refer to "Making MIDI Work for You" in the June 1985 issue of **EM**). Just to recap, passing the MIDI signal through more than a couple of optoisolators distorts the digital signal due to the sensor's comparatively slow response time. The best solution is to use an active splitter for the MIDI signal, referred to as a MIDI Thru box. This device takes one MIDI input and distributes it to a number of identical outputs. However, since the MIDI spec requires that each MIDI transmitter drive one and only one receiver, it is not a simple matter of just wiring a bunch of connectors in parallel. What is required is an electronic device known as an *octal buffer* to create eight separate MIDI transmitters from a common input. **Fig. 1** shows a MIDI Thru box circuit.

Before going one step further, I realize many of you are going to say "I can't build electronic devices." Well, if you ever thought you might want to try building something, this is the ideal "starter" project—you won't find anything much simpler. I will try to explain the construction in enough detail that a novice could figure it out; if you are experienced in electronics, you can skip this explanation and start building from the schematic. Those who need an even more basic explanation of electronic construction can refer to the book "Electronic Projects for Musicians," available from Mix Bookshelf.

CONSTRUCTION

The most time-consuming part of this project is, believe it or not, cutting the holes in the chassis box for the DIN connectors. Since these connectors need a 5/8-inch mounting hole, they are more difficult to install than standard phone jacks. I use a Greenlee hole punch to make the job easier, and would advise using a plastic enclosure as it is much easier to punch than metal. If you don't have a hole punch, drill a ½-inch hole and file it to size.

> *". . . if you ever thought you might want to try building something, this is the ideal 'starter' project"*

Probably the easiest way to build the circuit is with *perfboard*. This is a thin sheet of epoxy material drilled with holes spaced on 1/10th-inch centers; the leads from electronic components insert through these holes. After cutting about a three-inch by three-inch piece of perfboard, mount sockets for the integrated circuits on it and connect wires to the socket leads that protrude from the perfboard's bottom side. Use a light gauge (#24, #26, or #28) solid, insulated wire; strip an ⅛-inch of insulation from the end of the wire and wrap the bare wire around the integrated circuit (IC) socket lead with a pair of tweezers or *small* needle-nose pliers. Then solder the connection using a low wattage soldering pencil, but be sure not to use too much solder or it might short over to an adjacent lead. See DataBank for the IC pin numbering. For simplicity, I mounted the resistors on the DIN connectors, then ran wires from the resistors to the pins on the 74LS244.

Once you complete the wiring between the 74LS244 and DIN connectors (with resistors), all that remains is to make the connections for the optoisolator circuit and power supply. The optoisolator circuit is the standard MIDI circuit described in the original MIDI 1.0 specification. You have two choices for a power supply: 9V transistor radio battery or transformer. The battery approach has the

__Kirk Austin__ designed one of the first stand-alone MIDI keyboard controllers. He is employed as an assembly language programmer for an industrial controls company and creates much software for the Mac. In addition to writing for EM, he also contributes to several Macintosh magazines.

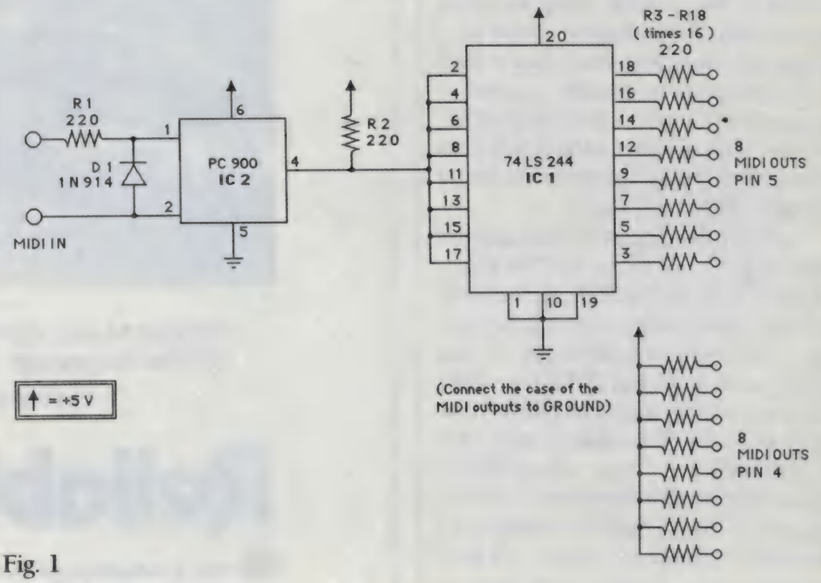

Fig. 1

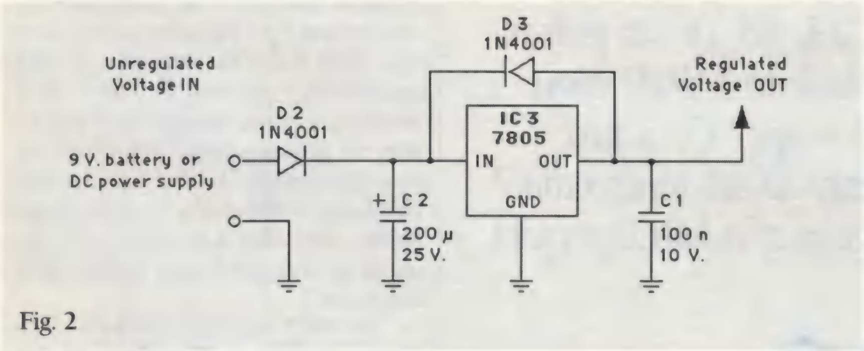

Fig. 2

advantage of one less power cord, while the transformer supply keeps you from having to replace batteries when they wear out. Caution: AC power supplies use potentially lethal voltages. If you are at all unsure of your abilities in electronics, we urge you to use a battery supply.

For the transformer, I would recommend one of the 9 volt DC battery eliminator types available from Jameco Electronics in Belmont, CA. Whether you use a transformer or battery, you also need a voltage regulator to convert the unregulated battery or transformer voltage into a regulated (stable) +5 Volts, as required by the ICs. The 7805 voltage regulator chip, along with a capacitor and diode, make this conversion. Mount these components on the perfboard wherever you find it convenient and wire them up according to **Fig. 2**.

HOW IT WORKS

The circuit itself is pretty simple; it just takes the MIDI signal from the optoisolator and applies it to the inputs of the eight buffers in the 74LS244 chip. Then the buffer outputs are routed through 220 Ohm resistors and on to the individual MIDI output jacks. To make a MIDI Thru box with more outputs, simply add another 74LS244 alongside the first one, connect the inputs together, and voila—a splitter with 16 outputs. (Note that by using the 74LS244 chip, you can drive longer cables than you could with a standard part like the 74LS04; this is because the 74LS244 is actually designed to be a line driver and therefore supplies more current than a standard gate.)

If this is your first project, then I congratulate you in advance for taking it on. You will find that there are many simple projects that can provide you with very necessary capabilities for a minimal cost. . .and the MIDI Thru Box is an excellent place to start. **EM**

PARTS LIST

Resistors

R1-R18	*220 Ohms*

Capacitors

C1	*100n, 10 Volts*
C2	*200u, 25 Volts*

Semiconductors

D1	*1N914*
D2, D3	*1N4001*
IC1	*74LS244 buffer*
IC2	*PC900 optoisolator*
IC3	*7805 +5V regulator*

Miscellaneous

20 pin IC socket
6 pin IC socket
Perfboard, solder, wire, etc.

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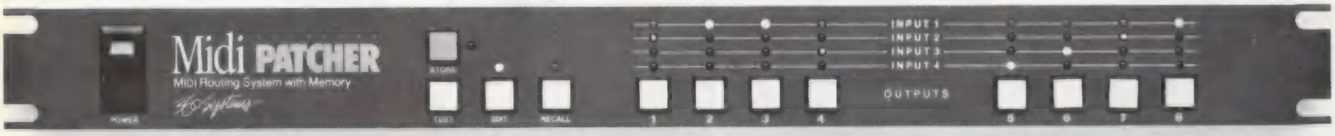

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Need to convert a 24, 48, or 96 pulses-per-quarter note clock to MIDI? How about MIDI sync-to-tape? Or a just plain MIDI clock with an easy-to-set tempo dial? They're all yours with this gem of a MIDI project.

The "Small Tock" MIDI Clock

BY TIM DOWTY

This simple project generates MIDI clock signals in response to either an external pulses-per-quarter note (PPQN) input or to a manually set tempo knob.

The Small Tock (ST) can slave to older sequencers or drum machines (Drumulator etc.), or—in the stand-alone mode—act as a master clock for your other MIDI gear. Additionally, many sync-to-tape schemes end up extracting a sync signal from tape and producing a 24 pulses-per-quarter note signal; these pulses can be translated into MIDI clock signals by the Small Tock to provide a simple MIDI sync-to-tape setup.

Before we dive into the studio and start clicking away, let's first take a detour and find out what makes the ST tick.

Tim Dowty *is a guitarist with the San Diego-based synth trio "Elemental P." He is also a software engineer with InterOcean Systems, where he works on programs that help track oceanic phenomena (such as temperature variations or wave analysis).*

MIDI CLOCK SIGNAL BASICS

From the point of view of your MIDI instruments, MIDI is a highly specialized language. Speakers of this language communicate with each other using a set of rigidly defined electronic "words." And of course, wherever there are words, lurk dictionaries. Special languages require special dictionaries, so let's get the "dictionary" known as the official MIDI specification.

Glancing through the dictionary, we come upon the definition for a word called "Timing-Clock-In-Play." Its slang equivalent is also listed: "MIDI Clock." There are two ways to talk about this concept in English, but in MIDI—the electronic language—there can be only one precise definition and but a single acceptable spelling. People need ambiguity and color, the very lifeblood of art; but machines, on the other hand, thrive in a world of exactitude—black and white. Off and on. Low and high. It's exactly this binary need that the MIDI language is meant to fill.

The MIDI dictionary defines MIDI Clock as: "The signal to which the system is synchronized at a rate of 24 clocks per quarter note." An electronic utterance of this word down the line tells all MIDI instruments (assuming they are in play mode) to advance through the sequence they are playing *exactly 1/24 of a quarter note.* (Incidentally, 1/24 of a quarter note equals one member of a 30-second note triplet. This value may ring a bell if you use an auto-correct feature on your MIDI sequencer.)

The MIDI dictionary gives the clock signal's spelling as "11111000." At first glance, this may look utterly meaningless, but it begins to make sense when you remember that:

✓ There are only two letters in the MIDI alphabet: "off", written as "0", and "on," written as "1." This keeps two-tone machine sensibilities on track.

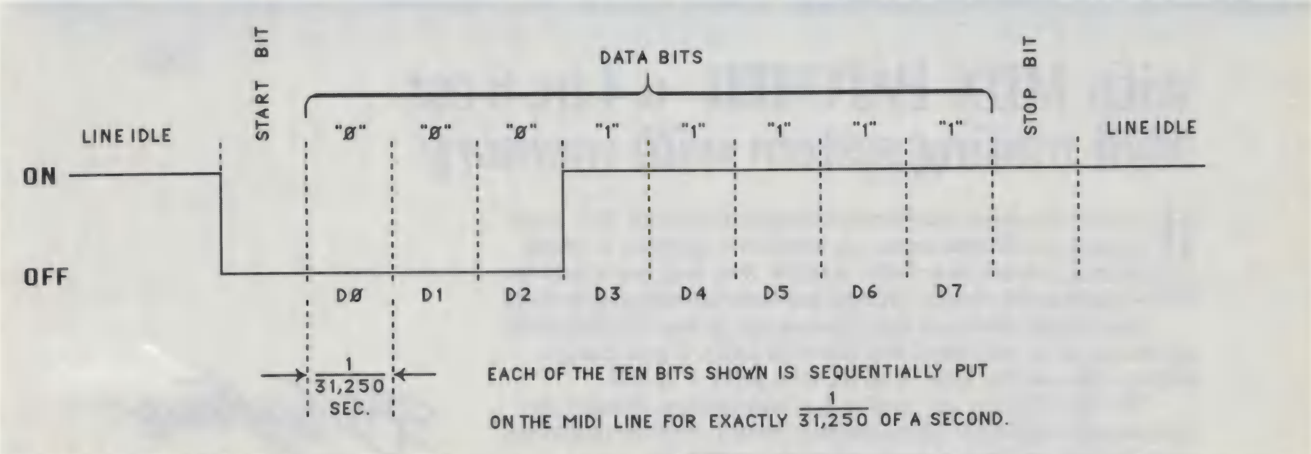
✓ Every word is exactly eight letters long. This lets all receiving machines know exactly what form to expect data in, and at the same time provides information in easily digestible chunks.

An eight-letter word is known in technoid circles as a "byte." Four-letter words are known as "nybbles" (or "nybls"), and the letters themselves (ones and zeros) are called "bits."

We now know how the MIDI Clock signal is "spelled" and that it must be uttered at 24 times the quarter note tempo, so let's move on to how MIDI "speaks" its language.

MIDI DICTION

Perhaps one of the reasons machines find MIDI so much more comprehensible than people do is MIDI's heavy computer accent. Most MIDI designers find MIDI's drawl a friendly touch, though, since they are able to use well-established conventions and protocols for many of the nitty-gritty communications details. The ST (like all MIDI equipment) hangs on these



EACH OF THE TEN BITS SHOWN IS SEQUENTIALLY PUT ON THE MIDI LINE FOR EXACTLY $\frac{1}{31,250}$ OF A SECOND.

Fig. 1: *The MIDI Clock WORD as it's "pronounced" over MIDI*

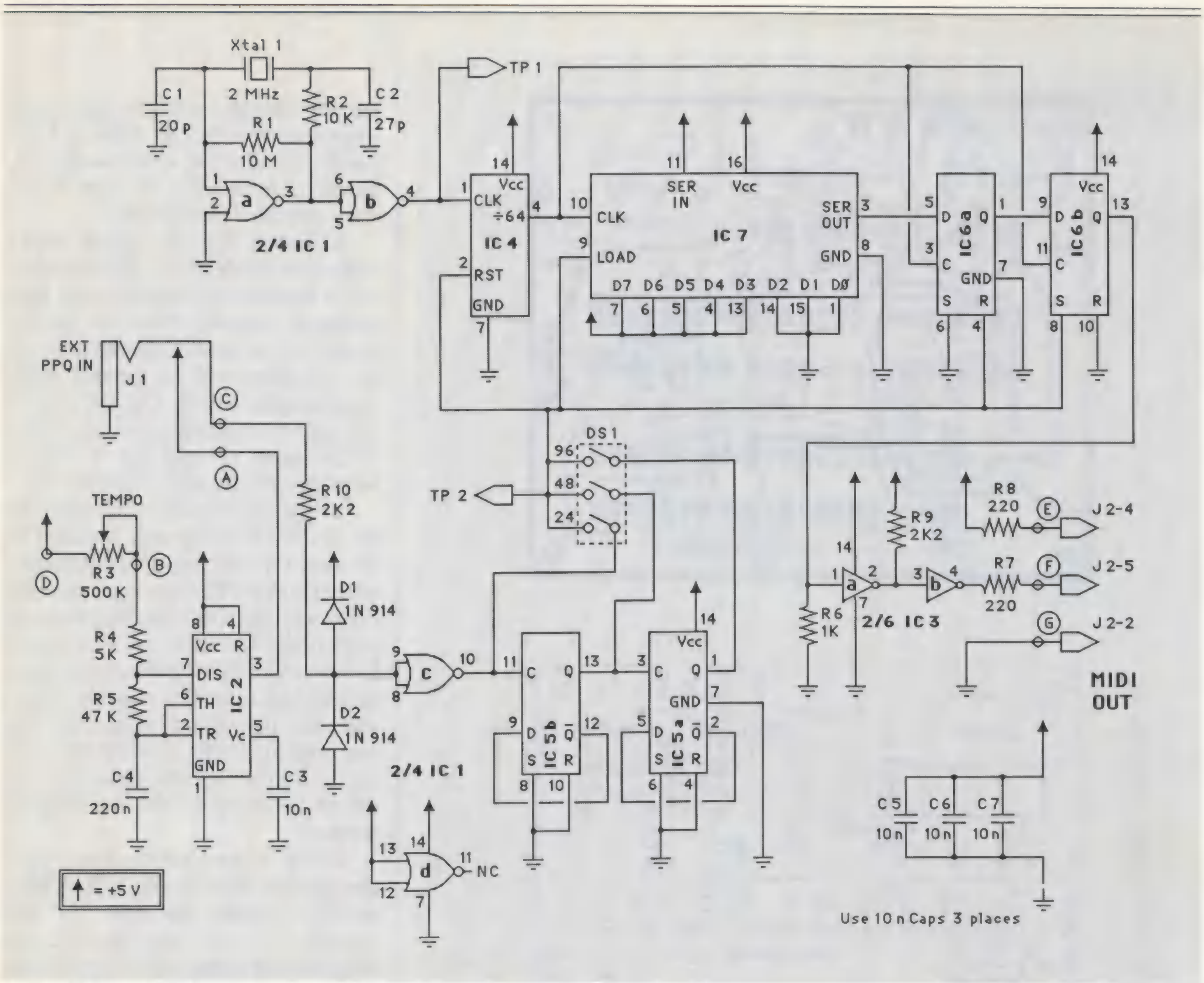

Xtal 1
2 MHz
C1
20p
R1
10 M
R2
10 K
C2
27p
2/4 IC 1
a
b
TP 1
IC 4
CLK
÷64
RST
GND
Vcc
IC 7
CLK
LOAD
SER IN
Vcc
SER OUT
GND
D7 D6 D5 D4 D3 D2 D1 DØ
IC6a
IC6b
D
Q
C
S
R
GND
EXT PPQ IN
J 1
TEMPO
R3
500 K
R4
5K
R5
47 K
C4
220n
IC 2
Vcc
DIS
TH
TR
GND
R
Vc
C 3
10n
R 10
2K2
D1
1N 914
D2
1N 914
TP 2
DS1
96
48
24
c
2/4 IC 1
d
NC
IC 5b
IC 5a
R9
2K2
R6
1K
2/6 IC3
R8
220
R7
220
J2-4
J2-5
J2-2
MIDI OUT
C5
C6
C7
10n
10n
10n
Use 10 n Caps 3 places
↑ = +5 V

Fig. 2: *Small Tock schematic*

familiar conventions, which, in their essence, boil down to a widely used serial dialect first spawned in the dim prehistory of the computer age.

"Serial" means that bytes are sent one bit at a time over a single wire as opposed to "parallel" communications, where a separate wire is used for each bit and all eight bits are sent simultaneously. Parallel schemes are good where fast communication over short distances is required, such as inside computers and along circuit boards. Serial works best where longer distances are involved.

In addition to the one-bit-at-a-time rule mentioned above, the serial protocol also requires that bytes be sent "backwards" with the rightmost (as written on paper) bit sent first and the leftmost bit sent last. Thus the MIDI clock byte, "11111000," which is converted to a serial bit stream by the ST, is sent out right to left with a "0" first and a "1" last.

Another funny thing about MIDI diction is that two special bits must be sent with every byte in addition to the eight data bits. The *start* bit is always a "0" (off) and the *stop* bit is always a "1" (on). The extra bits allow receivers on the line to sync up to the serial data being sent. The addition of these "padding" bits is yet another task that must be performed by the ST.

> *"The Small Tock (like all MIDI equipment) hangs on a . . . serial dialect first spawned in the dim prehistory of the computer age"*

Finally, all MIDI communication takes place at the rate of 31,250 bits per second and between words, when there is no communication going on, the line must be held in a constant "1" state. Another job for the ST.

Fig. 1 graphically depicts the MIDI Clock signal, computer accent and all, in the form that it finally ends up being pronounced over MIDI by the ST.

THE SMALL TOCK CIRCUIT

The computer world has given us a family of complicated ICs called UARTs (Universal Asynchronous Receiver/Transmitters) that take care of parallel to serial conversion, bit padding, and timing for us. (See Thomas Henry's article, "Fun with UARTs," in the January 1986 issue of **EM**.) They are infinitely useful wherever two-way communication is involved, especially if computers are doing the communicating. (UARTs are at the heart of all MIDI computer interface cards.) The ST began life with a UART, too, until I realized that the task at hand required far less horsepower than a full-bore communications chip.

Referring to the schematic (**Fig. 2**), our "UART" comprises IC7, a 4021 eight stage shift register, and flip-flops IC6a and IC6b. The bit rate is set by the bit clock built around IC1a, IC1b, and IC4. The bit clock's output, a rock-steady 31.25 kHz square wave at IC4 pin 4 couples to the UART's clock inputs. Each clock pulse from the bit clock moves bits rightward

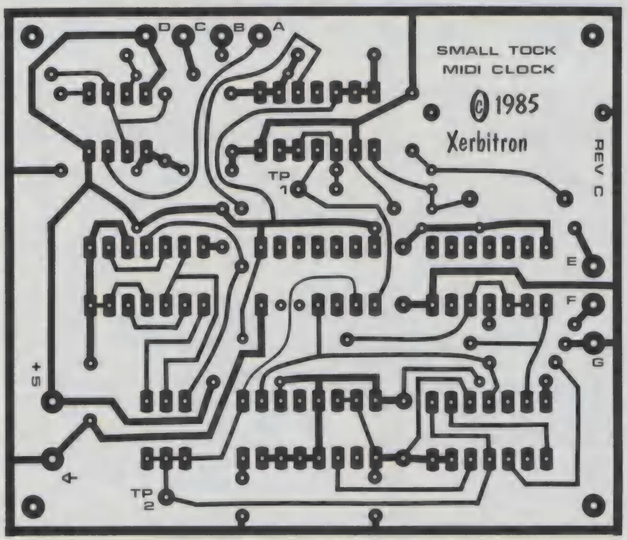


Fig. 3

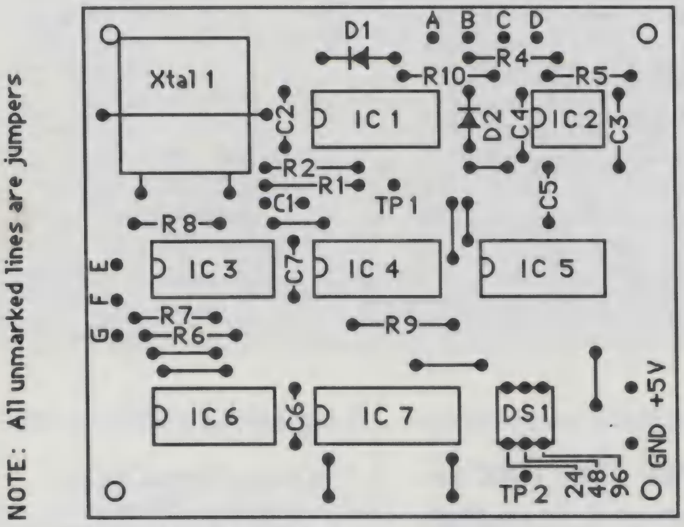


Fig. 4: *Small Tock—PC board parts placement*

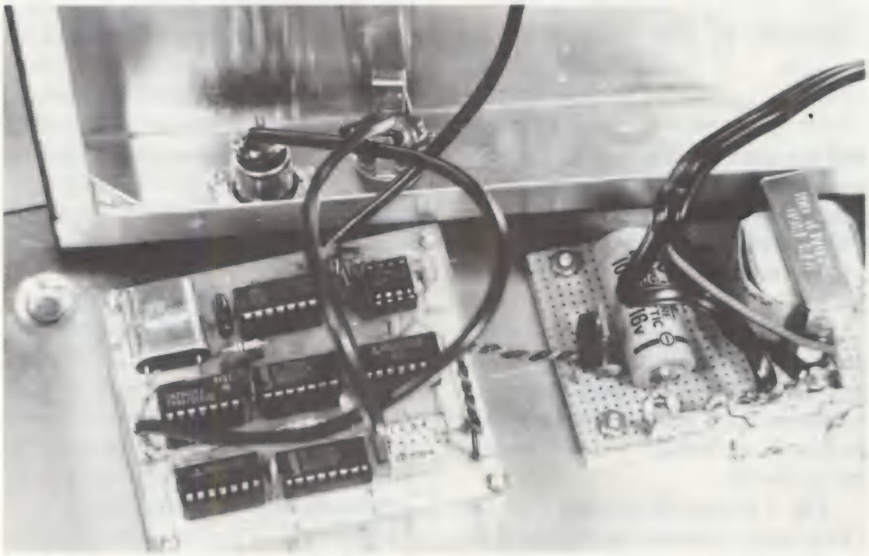


Fig. 5

one step through the 4021's eight internal storage registers, through IC6a, and ultimately through IC6b, whose output couples to the MIDI line via IC3a, IC3b and their associated components.

IC5a an IC5b form a tapped divider chain with divide by 1, 2, and 4 outputs. IC2, a frequency-adjustable square wave oscillator, normally drives the divider chain, but the internal timekeeping can be overridden with an external PPQN input coupled into J1. R10, D1, and D2 form a protection network so that external PPQN signals going above +5 Volts or below ground can still control the ST.

DS1 selects the proper divider tap for the PPQN rate being used. It should be set so that we end up with 24 pulses per quarter note at TP2. If you envision using the ST with lots of different PPQN sources you'll probably want to use a 3-position DIP switch for DS1 to make changing the divider taps as easy as possible. Otherwise, just permanently jumper the tap you need for 24, 48, or 96 PPQN. If you use the internal oscillator, be sure to select the 24 PPQN tap for the best range of tempos.

So now we have a bit clock running at the required MIDI bit rate of 31.25 kHz, which is moving bits down the line through IC7's eight stages and the two single storage registers (IC6a and IC6b). The circuitry around IC3a and IC3b takes IC6b's output, makes it palatable to the MIDI line, and sends the bits out. So, we have a (possibly divided) square wave at the rate of 24 PPQN present at TP2.

Between TP2 pulses, the "1" present at IC7's serial input (pin 11) gets clocked down the line in lieu of the parallel inputs, which holds the MIDI line high. Pulse action at TP2 (which occurs at a 24 PPQN rate) starts things happening. Each pulse loads IC7 with the bits present on its eight data inputs (wired here as the MIDI clock byte), and simultaneously loads IC6a with a "0" to serve as the start bit and IC6b with a "1" that gets tacked on to the already-present "1" state of the MIDI line. This first-in-line "phase absorber" bit is necessary since the load pulse appears at random times with respect to the bit clock.

Following the TP2 load pulse, the very next pulse from the high frequency bit clock moves each bit one register to the right with the bit currently in IC6b appearing on the MIDI line. As the bits of the MIDI clock byte get shifted along, the serial input bit (wired to "1") is shifted in repeatedly so that once all of the parallel loaded bits have fed the output, a long

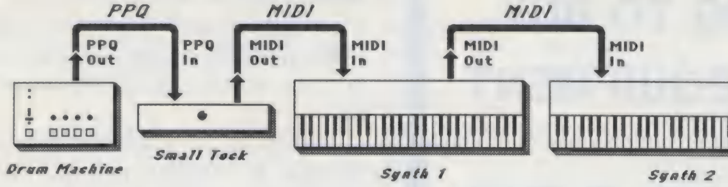


Fig. 6: *Small Tock slaved to an external PPQ device*

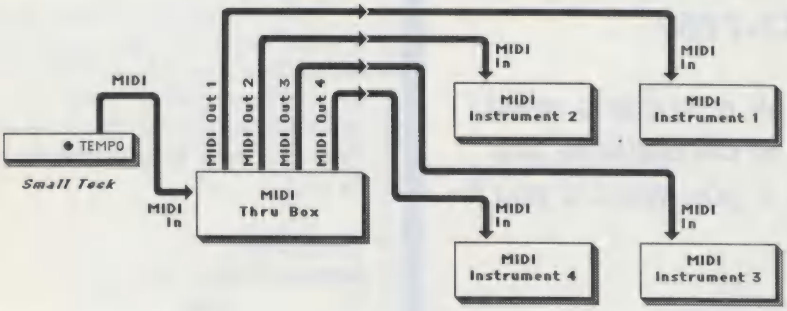


Fig. 7: *Small Tock in stand-alone mode*

string of "1" bits follows until the next MIDI clock byte. Since there will be several thousand bit clocks before the next TP2 load pulse, we are automatically assured of the one required stop bit (and then some!) before the next byte is shifted out.

CONSTRUCTION

Printed circuit board construction is recommended since it greatly simplifies assembly and improves reliability, but other methods will work too. **Fig. 3** shows the Small Tock printed circuit board, **Fig. 4** gives the parts placement. Off board connections on the schematic are keyed to the circuit board where the tempo pot, J1, and J2 connect. For best results, use shielded cable when hooking up the off board components.

The almost-all-CMOS design makes for a low power circuit, but be sure to terminate all unused CMOS inputs—tie IC1d pins 12 and 13 to the positive supply or to ground! Also sprinkle a few 10 nF (0.01 uF) bypass capacitors (C5-C7 in the schematic and the PC parts layout) into the circuit between the power supply positive and ground. It's best to connect these close to the ICs.

The ST fits in a small case with a well-regulated +5 Volt supply as shown in **Fig. 5**, or can be permanently installed inside a sequencer or drum machine. The latter requires extreme care and voids the warranty, so it is advised only for the experienced technoid. Nonetheless, the inside installation can be a good way to go since power and clocks are often available from existing circuitry.

OPERATION

To slave the ST to a device generating a 24, 48, or 96 pulses-per-quarter note (PPQN) timing signal, simply patch your PPQN signal into J1, making sure that DS1 is set for the proper pulse rate (**Fig. 6**). The external PPQN device sets the tempo. **Fig. 7** illustrates the ST operating in the stand-alone mode driving several instruments by means of a Thru box (for more about Thru boxes, see Kirk Austin's article in this issue of **EM**). R5, the front panel tempo pot, sets tempo.

In case of difficulty, note that the ST's PPQN input requires a *fast, rising* pulse. Tests with a Yamaha RX-11 revealed that PPQN outputs conditioned for recording on cassette tape may not clock the ST cleanly. In some cases, a pull-up resistor at IC1C pin 10 solves the problem, but the best solution is probably to add a Schmitt trigger gate (such as a 4584) between the offending PPQN signal and the circuit input. Standard PPQN signals and most cassette signals that aren't divided down by the ST work just fine.

MIDIMIX MIDIMIX MIDIMIX
MIDIMIX MIDIMIX MIDIMIX
MIDIMIX MIDIMIX MIDIMIX
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MIDIMIX 9 is a 4 input mixer for merging midi signals. There are 4 output channels, each programmable, giving 4 different mixes of the 4 inputs. An analog clock input is also provided to convert drum machine / tape sync tone to midi clock. Each input and output may be muted and unmuted at any time safely. Eight memory pages save mix and mute combinations for quick recall. Each output has a clock filter and running status defeat filter. The Solution ! MIDIMIX 8 is a rack mount version of model 9. MIDIMIX 9' is 2 model 9 in a rack mount that can hold 3 (model 9'). 9' = $695 9' = $995

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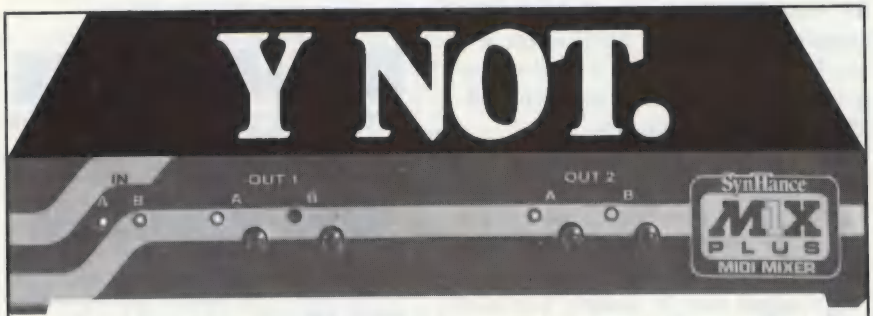

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ENHANCEMENTS

To eliminate the need for a Thru box, use a few of the spare IC3 inverters to drive additional MIDI outputs. Drive the extra inverters with the signal present at IC3 pin 2.

The spelling for MIDI "Start From First Measure" is "11111010," only one bit different from the MIDI Clock spelling. With a pushbutton switch and a few more flip-flops, it's possible to add a "Start Over" feature to the ST. The only "gotcha" here is the requirement that the first MIDI clock follow within 5 ms of the Start From First Measure word.

Well, here you have it! Proof that you can teach your old dog a couple of new tricks. The ST has enhanced my setup in the studio, simplified matters on stage, and breathed new life into some of my older equipment. I hope it does the same for you!

PARTS LIST

Resistors *(¼ Watt, 5%)*

R1	*10M*	
R2	*10K*	
R3	*500K*	*pot*
R4	*5K*	
R6	*1K*	
R7, R8	*220*	
R9, R10	*2k2*	

Capacitors *(5 or more working Volts)*

C1	*20p*
C2	*27p*
C3, C5-C7	*10n*
C4	*220n*

Semiconductors

D1, D2	*1N914*	*General purpose diode*
IC1	*4001*	*Quad NOR gate*
IC2	*555*	*Timer*
IC3	*7405*	*Open-collector inverter*
IC4	*4024*	*Divider*
IC5, IC6	*4013*	*Dual D flip-flop*
IC7	*4021*	*Eight stage shift register*

Miscellaneous

J1	*Closed circuit ¼-inch mono phone jack*
J2	*5-pin DIN jack*
X1	*2.00 MHz microprocessor crystal*
DS1	*3-position SPST DIP switch*

The ST also requires a well-regulated +5 Volt DC power supply capable of providing at least 50 mA. For a suitable circuit, see Kirk Austin's article "I'm Thru with MIDI" in this issue.

For information on parts kit pricing and availability, write to Tim Dowty c/o **EM**, 2608 Ninth St., Berkeley, CA 94710.

EM

Reticon's recently discontinued family of "SAD" delay line chips formed the core of countless analog flangers, chorus units, and delays . . . but their new chip family promises even more.

Good-Bye to the SAD-1024

BY JACK ORMAN

E G & G Reticon has phased out their family of Serial Analog Delay (SAD) chips, including the SAD-1024, SAD-512, and SAD-4096. Fortunately, though, a series of improved delay lines has been introduced to fill their places.

The SAD-512, 1024, and 4096 have given way respectively to the R5106, R5107 and R5108. (Note that the R5108 is a 2048 element delay, which comprises half the number of elements in the SAD-4096; therefore, two R5108s are required to provide the same amount of delay as a SAD-4096 for a given clock frequency.) These new chips have been standardized, not only in size (standard eight-pin mini DIP package) but also in operating parameters. This greatly simplifies their use. With these latest bucket brigade analog delay devices, a circuit's basic delay time can be changed merely by substituting a different chip from the series (for example, a long delay chip can replace a shorter delay chip if you want to convert, say, a flanger into a chorus or slapback delay unit). This standardization is a great help when designing circuits and laying out pc boards.

An important point is that the recommended supply voltage (Vdd) for the R5100 series delay chips is 12 Volts, as opposed to the 15 Volts used by the SAD family. The bias voltage (Vbb) is internally derived from Vdd and is about 2 Volts lower than the supply voltage. The R510X family requires a load resistor of about 20k Ohms from Vbb to ground to set the operating level; best operating procedures derive the input bias voltage from Vbb.

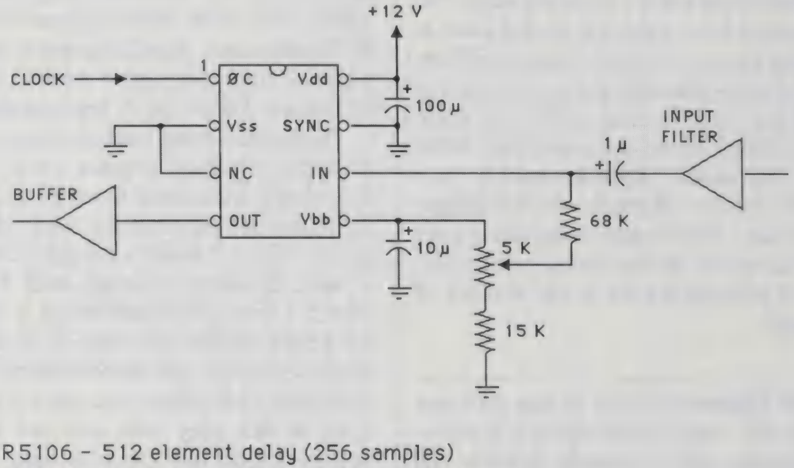
Onboard clock drivers on the new chips help cut the parts count and greatly simplify design procedures—forget about the dividers, two-phase square waves, and sometimes high-current buffers used by the SAD-1024 and SAD-4096. The only clock requirements of the R510X family is rise and fall times of 50 ns or faster, a pulse on time greater than 200 ns, pulse off time greater than 300 ns, and a clock magnitude between 2 Volts and Vdd. This single clock frequency sets the delay time. Pin 7, a sync input, is used when connecting two or more delay chips in a parallel or series combination; ground it when you're using a single delay chip.

To prevent aliasing, the analog input should be limited to a bandwidth that is one half of the sample frequency. For distortion of 1 percent or less, restrict the input signal to 1.5 Volts RMS. Signal distortion will be at least halved if the input is restricted to between 0.75 and 1 Volt RMS.

> *". . . standardized . . . size (and) operating parameters . . . greatly simplifies their use"*

You'll be happy to know that the output trimpot and summing network required by the SAD family to cancel the residual clock signal is no longer necessary—an onboard sample-and-hold circuit provides excellent clock cancellation. However, due to the high output impedance of the sample-and-hold, an emitter follower or other high-impedance input buffer is needed to prevent excessive loading.

If there is any drawback to the new chips, it must be cost. As of this writing, single chips cost $17 each and are available direct from Reticon. I have an R5106 on hand at present and am working up a flanger circuit using it; however, with the ease of design and reduced part count offered by the new chips, I'm tempted to put together a harmonizer circuit that I've been kicking around for a year or so. Any interest? Now, if Reticon would only make a tapped delay chip suitable for making an analog reverb . . . **EM**



R5106 - 512 element delay (256 samples)
R5107 - 1024 element delay (512 samples)
R5108 - 2048 element delay (1024 samples)

Fig. 1

Tangerine Dream has been at the forefront of musical electronics for over 15 years—and as you'll read in this interview, they've learned a lot in that time.

Tangerine Dream

BY JOHN DILIBERTO

In 1985, a small milestone in electronic music occurred: Tangerine Dream became 15 years old. In that time, they've defined and expanded the parameters of electronic sound by travelling through psychedelia, space music and the current New Age movement.

The recent explosion of synthesizer technology can be traced in large part to the personal, highly developed music of Tangerine Dream. Their first recording, *Electronic Meditation,* was a Stockhausen songbook played by acid heads. Electric guitars, organs, violins, metal, whips and cellos were distorted to the limits by founder Edgar Froese and Conrad Schnitzler, and set against Klaus Shulze's free jazz drumming (still acoustic in those days). Schulze, now a highly regarded synthesist in his own right, recalls the radio stations' reactions. "While it was playing," he laughs, "they'd give us these strange looks like there was something wrong with the turntable."

Things got even more curious on their next three recordings, *Alpha Centauri, Atem* and *Zeit,* with the gradual introduction of Mellotron and the VCS3 synthesizers. The personnel also stabilized around founder Edgar Froese, Christoph Franke and Peter Baumann—probably the only element of stability in a floating world that made Pink Floyd sound like a rural blues band by comparison. *Alpha Centauri* bears a dedication to "all people who feel obliged to space." They experimented with subtler textures and on the double record *Zeit,* used a string quartet in the manner of Ligeti.

John Diliberto*'s articles on jazz, rock, and electronic music appear regularly in several magazines. He is currently president and chief producer of Pennsylvania Public Radio Associates, producers of the award-winning radio series* Totally Wired *(as well as several other radio programs on new music).*

Tangerine Dream had a curious breakthrough in 1973 with *Phaedra,* a recording that remains fresh and visionary. A Moog synthesizer was added along with sequencers, a development that, until recently, would be a trademark of their music. *Phaedra* topped the British pop charts with its liquid textures and insistent rhythms that sounded like giant cosmic rubber bands.

It was during this period that T. Dream honed their reputation as a performing ensemble, playing odd venues like planetariums and darkened churches throughout Europe. Their concerts were almost entirely improvised, with only a few preprogrammed sequencer patterns. They were, and still remain, one of the only live performance electronic ensembles and one of the few who can pull it off with the quality and complexity of their studio recordings, as the live records *Ricochet, Encore, Tangerine Dream, Logos* and *Poland,* will attest.

They finally came to America in 1977, by which time they'd acquired a synthesist's candy store overflowing with state-of-the-art equipment. In 1977, that meant instruments like Oberheim polyphonic synths, ARP 2600s and string machines, PPG synthesizers, digital sequencers, and a host of custom-designed devices. The LP notes to *Encore* list 25 instruments.

Tangerine Dream had little impact in an apparently huge, popular sense, but they slowly insinuated themselves into the Hollywood film industry. When they scored William Friedkin's *Sorcerer* in 1977, it was a dynamic departure; aside from Wendy Carlos' *Clockwork Orange,* it may have been the first time that an all-electronic score was used for something besides eerie sound effects in science fiction films. In fact, they have only one true science fiction film credit to date, the low-budget *Wavelength.*

The 1980s find Tangerine Dream firmly ensconced in films, with over a dozen credits from taut action thrillers like *Thief* (directed by *Miami Vice's* Michael Mann) to the teen hit, *Risky Business.*

A partial listing of their other film credits include *Firestarter, Flashpoint, Heartbreakers, Kamikaze 1989* (Froese only), *The Park is Mine* (HBO), *Red Heat, Forbidden,* the *Streethawk* TV series, and though you'd never know it from the soundtrack recording, *Vision Quest.*

I talked with Tangerine Dream while they were in London doing final mixes on *Le Parc* for their new label, Jive-Electro (Relativity in the U.S.). It's a recording of shorter, highly energized tone poems that still retain the Dream trademarks of spectacular sounds and enveloping compositions. Their early reputation as a hippie space music band is belied by their now tightly structured music and efficiency. Roddy MacKenna, from Jive-Electro, was shocked by how fast they mixed *Le Parc.* "I booked a couple of days of studio time," he exclaimed, "and they only took a few hours." An engineer added, "They knew exactly what they wanted and how to get it."

I spoke with two-thirds of Tangerine Dream. Edgar Froese is philosophically introspective when he discusses his art, while Chris Franke's humorously cynical air places Tangerine Dream in the context of the music world at large. The third member is Johannes Schmoelling, who replaced Baumann in 1980.

Electronic Musician: When we spoke in 1982, shortly after *The Soldier* was released, you said you were going to stop doing soundtracks for a while and you stopped for about a year. But since then you've done quite a few.

Edgar Froese: We had some problems with our record company; in a commercial market you sometimes have to do what you get asked to do. Also, the worldwide recession in record sales affected us. So after a year, we stepped into movie making again so that we could be independent and do what we wanted. It wouldn't work if we tried to live from just record sales and also want to buy expensive equipment.

Chris Franke: Soundtracks are always a learning process because you get forced to design music that you wouldn't have done by yourself for a record or concert. In the end it gives you more material and routine knowledge of the instruments, which is valuable. So movie making isn't just making money or films that we like . . . it's a process.

EM: Weren't some of the things in *The*

Keep used in your *Poland* live record?
Franke: Ideas of it, right. We would never go so much into classic music or meditative music like we did on *Risky Business.* Film music is a playground for us where we can play a style that we like but doesn't fit into Tangerine Dream.

EM: That's interesting because on *The Keep, Thief* and *Risky Business* there is music that I recognized from Tangerine Dream LPs. Did you re-record it for the film?

Franke: Actually, we recorded all original music for *Risky Business,* but the director had used tracks from our other records and he wanted that music. So, they were variations of existing titles.
Froese: That was the director's idea; we wouldn't have done it otherwise. We don't like to repeat things we've done.

EM: How do you select the films you do?
Froese: It's not always the story or the way the film is done, but little points that determine whether we do it or not. For instance, two films, a Conan one and a Charles Bronson film were offering us a lot of money but we decided not to do it. I'm not saying that they're bad films. It's nothing about the films.
Franke: Directors must realize that we've been a performing group for many years and we have a following of people who buy our albums and they think that we have ideas about a film or identify with a story. They don't understand if we do a totally violent film or a really cheap sex film. We would lose our followers and image very soon if we did every film.

There are not many films that we really like to do from our real heart. We always thought that *2010* would be the right kind of film for us. We could have done good things without using the usual orchestra. If the film *Dune* had been a great film, which it unfortunately was not, that would have been the right material. Films like *Missing* are more the style that we're looking for.

EM: On *The Sorcerer,* you composed one long score based on the script and then William Friedkin chopped it into the movie. Now that's not the way you usually work.
Franke: Each film is different. Some give us all the freedom we want. Some work with us, they play instruments and we work out tunes together. (Michael Mann plays guitar on *Thief.*)

> *"We want to be different, break certain routines and cliches of film music that are worn out"*

Sometimes to be different we create more work than is necessary. We want to be different, break certain routines and cliches of film music that are worn out. We try to create counterpoints, do the opposite of what the film is doing or else sometimes you don't even hear the music.

In *The Keep* there was a scene with a very sad feel but we did a cool music to it. Or there was very fast action and we did slow motion music. In *Risky Business,* during a love scene instead of doing strings, we did a minimal rocky pedal music that still worked although nobody expected it.
Froese: By working with electronics we can be much faster than a person who works with a normal score and orchestra. Even so, the work we do in two or three weeks is hard. We're completely exhausted afterwards. We have to concentrate on four or five different levels as composers, arrangers, players and technicians all in one. That's good, though, because we can control all the parameters. Nothing has left our studio without being exactly like we want it.

EM: When I hear the film music, I think it's different from Tangerine Dream music. First of all, there's less of it . . . there are things left out.
Franke: We don't have the structural development like in Tangerine Dream; in films you cannot develop—the dialog disturbs it. Still, we try to keep our signature

even though we must relate to the film. Also, there's less of a spectrum because of sound effects and other things so you have to express the full musical score in fewer lines. That's why it's different from the music we'd do ourselves.

Froese: You can use one cello, and in the length of three minutes create something incredible and strong.

Franke: That's the art, I think, to create pauses with simple acoustic events for what's required in the film. That's why directors hire us. Most are looking for the worn out big orchestra sound. I don't like to listen to classical music anymore because it's all in film scores. Many modern music styles are used for horror films and space films.

EM: What about working with sound effects? You don't generate them, do you?

Froese: In *Thief*, when they break into the roof to get into the bank, that sound filled the whole frequency range. We measured it and worked in the same frequency range for the music and it became a marriage between effects and music.

Franke: We don't do sound effects, but we care about them and we always ask for as many sound effects on the tape as possible. With electronics, it's easy to adjust our music to sound effects; we can record an effect from the tape and play a melody with it. In some films, we store a particular sound in the computer, modify it and what comes out is used in the film instead of the original sound effect. We don't necessarily like to do sound effects—we want to be musicians. But if you get asked to do that and it helps the film, you do it.

EM: In 1982, you weren't doing much sampling. I think you had just gotten the Emulator and you had the PPG which didn't have sampling then.

Froese: The situation has totally changed. We have the PPG 2.3 and Synclavier—very expensive units, by the way.

EM: How have they changed your music?

Franke: They've made it a lot easier. We can come up with creative ideas quicker and there's a whole new dimension of electronics and acoustics which before were hard to combine. Electronic instruments were missing the subtlety of acoustic instruments. It brings not only speed but imagination; now you can make things that you just dreamed of before. For instance, we take one second of tape with ten instruments playing a ridiculous sound which will be completely different in a different octave and length. You can make transitions where one instrument fades into another sound. Sound color is even more important than before.

Tangerine Dream Selected Discography

Electronic Meditations (Ohr OMM 556004)
Zeit (Virgin VD 2503)
Alpha Centauri/Atem (Virgin 2504)
Phaedra (Virgin 2933-723)
Rubycon (Virgin V2025)
Ricochet (Virgin V2044)
Stratosfear (Virgin V2068)
Sorcerer (MCA 2277)
Cyclone (Virgin V2097)
Force Majeure (Virgin V2111)
Tangram (Virgin V2147)
Encore (CBS 35014)
Thief (Elektra 5E-521)
Exit (Elektra 5E-557)
White Eagle (Virgin 204 563-320)
Logos (Virgin V2257)
Hyperborea (Virgin V2292)
Firestarter (MCA 6131)
Wavelength (Varese Sarabande STV 81207)
Flashpoint (EMI ST 17141)
Risky Business (Virgin V2302)
Heartbreakers (Virgin 207-212-620)
Quichotte (Amiga 855 819)
Poland (Jive Electro HIP22)
Warsaw in the Sun (Jive Electro T74)
Le Parc (Jive Electro 8.26135)
Epsilon in Malaysian Pale (Brain 0001.074)
Macula Transfer (Brain 60.008)
Ages (Virgin VD 2507)
Stuntman (Virgin V2139)
Kamikaze 1989 (Virgin 2255)
Pinnacles (Virgin V2277)
Electronic Dreams (Brain 0040.148)

The drums have really changed too. With the Emulator II, there are many split points and you can put one event on each key. We hook up a mallet controller to it so we can play the E-II on the keys or with the mallets.

EM: That's one thing that's really changed in your music. The mid-period records, *Phaedra, Rubycon* and *Ricochet* defined sequencer rhythms for electronic music and defined drum machine rhythms. Now you don't use those sounds much at all. The music has gotten much more percussive and complex.

Franke: We don't exchange, we add. We're still using those sounds, but we're also expanding our orchestra.

EM: But despite all of the records there are with LinnDrums and Fairlight sampling, when I go back to *Phaedra* or *Rubycon* they sound fresh again.

Froese: That's true. It's hard for us to say that but when we go back to the good old days it's still quite fresh for us. One has to be honest. Yet, one should use what's available. People who associate us with electronic music have possibly forgotten that the hardware was just a bridge to reach our musical goals. I still think that even without all that stuff we are still able to use our imagination and follow our fantasies; if you lose your imagination, then you cannot create anything—even if you've got the most expensive computer in the world.

Franke: Electronics were just one possible way to go. If some genius created a better Mellotron, maybe we'd just use acoustic bits and pieces. We didn't have to have the electronic synthesizer to create that style; the idea was there and then we looked for the instruments. Today kids get an instrument and see what they can do with it. Then they look around and start to copy which is okay, to start. We were in the position that we didn't have anyone to copy. We started from scratch.

> *"...if you lose your imagination, then you cannot create anything—even if you've got the most expensive computer in the world"*

EM: Are you aware that you've influenced a whole generation of musicians who have never played an acoustic instrument?

Franke: I think it's even more important today that parallel to learning electronic instruments, one should play a percussive instrument and voice to get a feel for music composition and production. Playing only keyboards can be a trap because they are just triggering devices.

Froese: I would also recommend that they learn a very conventional stupid piano and a very conventional stupid drum kit and control his voice. I don't mean learning how to sing but to understand what the vibration of the body means and that the body is an instrument itself. You can run and scream just to experience what you are in a physical sense. I would not recommend that someone take all the money they can and buy the newest equipment and wait for success; it's stupid. You have to understand what it means to create a tone.

EM: How has MIDI changed your live performance?
Froese: It's made things faster. You can combine sounds that before were very complicated to construct. On the other hand, a few things didn't work the way we thought. Analog and FM synthesis don't always fit together. There are a lot of flaws in the system but it's a good starting point.
Franke: A complaint about the cheap digital synthesizers is that changing the sound requires quite a bit of time and concentration, so we use the presets during a performance. However, we also still use the old analog synthesizers where you have easier, real time access to changing parameters.

The industry got rid of all the knobs to make it cheap. Playing the presets is very boring, even if you have hundreds of programs. Wendy Carlos would stop the machine every second bar and change parameters, and that made the music lively. Otherwise it's just one big synthesizer with one sound and character.

Now the industry better understands the relationship between the human being and the machine, and is building programmers to speed up the process. The interaction must be there all the time. The readouts are better now and you have the old knobs back again.

EM: On "No Man's Land" from *Hyperborea*, you created a lot of acoustic, ethnic sounds.
Froese: That was a sequencer with the PPG. It had a sitar sound in it and oriental things.
Franke: I think we'd just come back from Japan, hadn't we?
Froese: Yeah! What we do on tour is the concerts, but then we try and get as much inspiration as possible. Especially Asia, where so many things happen.
Franke: What I liked about this piece was that it was played completely on digital instruments but it didn't sound electronic at all. It sounded very acoustic.

EM: The music is getting very acoustic sounding . . . it has come full circle.

How much do you improvise on stage?
Franke: It's getting less and less, but we keep our sections where we have certain techniques of rhythms and harmonies where it's easy, or at least possible, to improvise. Then we have pieces that are completely arranged and pre-programmed.

We play more different styles now, which is good. In the early days, we'd play one piece for a whole evening that was just sound-color music, which is easily performed like a harmonic piece. We had special audiences, like playing two hours of sound-color music in a planetarium; people loved it.

But now we sell some records and we're playing in sports halls with 6,000-7,000 people and you can't just play this kind of music that only 500 or 700 people understand or like. So you do a variety. You go through some improvised parts, then song structures where only the solos are improvised.
Froese: The kids today, who are 12 years old, have a higher output of interest than we had when we were 25. They are more open and pick up more things than when I was that age.
Franke: They eat faster, they dress faster, they learn faster and they're concerned with a lot of music. A few years ago, one bought a record and listened to it for two weeks. Now they digest it faster and every week they're looking for new thrills.

EM: Do you feel you have to give them that thrill?
Franke: Well, we don't necessarily have to produce more or louder music, but our music has to be more dense and have more surprises and events. It's like a story or a film. We can't play out one idea for

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EM: I don't see Tangerine Dream as a Pop Music Phenomenon. How do you see yourselves?
Franke: We are popular in certain areas but we don't try to do conventional and commercial music, although we do have a certain commercial value. There's a type of person who doesn't want to listen to pop music; they're looking for a new experience and music that goes more into the mind than into the body for a good mood or just dancing. . . music that triggers ideas and impressions even after the music is over.

EM: What's your current equipment setup?
Froese: I think we've got everything that's available on the market! Remember, we started doing this 15 years ago.
Franke: That is a bit broad, isn't it? We are selective.

EM: You have all the high end stuff.
Franke: No, not really. We don't have a Fairlight. We have Emulators, PPG and Synclavier for sampling and digital producing. We have all the high end analog synthesizers like the Prophet 5, Oberheim, Jupiters, Memory Moogs, and Oberheim Xpander.

Polysynths have gone into the age of being polytimbral and multi-color. That's a big step forward. I even buy some toys because they are better than their reputation, like Casios, and the little Japanese companies doing stunning things.

EM: Do you still have the GDS (General Development System synthesizer)?
Franke: Yes, it is now MIDIed and part of the orchestra. This is the one that is similar to the DX7, but since the DX7 is easier to program, as is the Synclavier, we just use the GDS library now.

EM: What drum machines and rhythm units are you using?
Franke: We use the Emulator II as a drum machine. But I found a way also to use the (Sequential Circuits) Drum Traks hooked up to floppy disks to change the sound easily. We use Oberheim cards and something from Roland, all synched together and we have some custom devices as well.

EM: Do you compose with computer terminals?
Froese: Yes, we do. Sometimes it's faster to play in real time, but if you want to do something that's more complex or of a certain length, especially for film music, computers are easier. If you're sitting in a studio with the director beside you and you have to make a change, it's easier to do it in real time rather than sitting in front of a terminal.
Franke: And the programs always like to crash anyway.

EM: You seem to have all of the equipment that you need. Is there anything you would like to see invented to remove any remaining limits. . . or where do you feel the limits exist?
Franke: Ideas!
Froese: It's so simple. You have to develop yourself first. Then you look for the hardware that will help you create what you've developed inside yourself.

EM: So what ideas do you have for which the hardware does not yet exist to realize those ideas?
Franke: Everything can be done.

This Tangerine Dream interview is taken from Totally Wired Mark II: Artists in Electronic Sound, *a radio series on electronic music being broadcast on public radio stations throughout the U.S. in 1986.* Totally Wired *is produced by* ***John Diliberto*** *and* ***Kimberly Haas*** *for Pennsylvania Public Radio.* **EM**

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MIDI is breathing some new life into the wind instrumentalist's bag of tricks.

JL Cooper MIDI Wind Driver

BY FREFF

No question about it, anybody walking into my studio would think I was a keyboard player judging by all the sets of ivories lying about. But I'm not. I try, to be sure, but the truth is that what chops I may or may not have are on the axe I was reared with: the clarinet. Back in elementary school, I sensed something remarkably special about playing a woodwind instrument, a quality of expressiveness that more than compensates for the lack of chords and the restricted range of tone colors. This expressiveness lets you put your *heart* into every note, and make the instrument truly your voice.

The voice . . . that's the clue. The entire history of instrument design has been a quest to capture a subtlety and power equivalent to the human voice through means of wood, varnish, metal, hide, and electronics. Of these, the woodwind and brass instruments lead the pack in expressiveness because they directly extend the vocal apparatus we've spent hundreds of millennia evolving. All other instruments are shadows. (Think not? Prefer to make your stand with the piano partisans? Go ahead. But it's not for nothing that good keyboardists talk of "breathing" life into a performance, or that Keith Jarrett's mouth goes on automatic hum-along whenever he plays. Glen Gould did it too. All that power focused into their hands, all those years of training, all that genius, and still their voices broke free.)

Which brings me to the point. Synthesizers are not, ipso facto, expressive. They have explosively expanded our palette of timbral color, certainly that, but even after two decades you won't find a keyboard synthesist who can play a flute line as well and as expressively as a superb flautist can, or one who can lay out a "sax" solo to touch Coltrane.

I respect my keyboard-playing compatriots. I am in awe of the sonic miracles wrought by the new generation of digital sampling keyboards. And you know what? It doesn't matter. A room full of keyboardists could plunk away forever and never get it right, because they'd still be trying to breathe life *into* the music instead of just plain breathing the stuff, period.

As a player, I argue staunchly on the side of expressiveness—give me instruments with quirks and personalities, preferably multiple. More specifically, as a clarinet player, my biases and experience argue that sheer straight-from-the-soul emotion calls for woodwinds every time. But as a composer . . . well, more often than not I relegate the woodwinds to a portion of the whole idea, or throw them out altogether. I have this studio full of synths for a good reason: they give me sounds I can't get any other way. And I have the studio itself for a good reason, too, which is that with it I can beat some expressiveness into the wonderful wide world of tone colors those synths provide. (I think the *real* art in making music with electronic instruments isn't in the playing, it's in the mixing. That's where it happens or it doesn't. Show me an engineer who doesn't ride the faders and the EQ and the effects sends on synth tracks, conducting the performance, and I'll show you an engineer producing swill.)

A partial solution to my dilemma was a remarkable controller called the Lyricon Wind Driver. Essentially a sleek, silver "electronic clarinet," it translated standard woodwind playing techniques into control voltages and gates to control synthesizers. Computone, the now-defunct manufacturer, had terrible timing. All they wanted to do was introduce woodwind players to the wonders of synthesis, but in the late '70s not that many players were ready to make the acquaintance. Like the famous but unnamed jazz player who gave his Lyricon back to the company because he was disturbed by not having to soak the reed (which was there solely for reasons of familiarity and to make it easier to push the pitch bend lever with your mouth).

The nifty thing about the Lyricon was that it was incredibly expressive, and considerably more fluid than a keyboard, when correctly attached to a good synthesizer. What with volume responding instantaneously and perfectly to variations in my breath, and a six-octave fingering range, and that little lever behind the reed responding to mouth pressure with a control voltage that I could use to trigger new events, or bend pitch, or open and close filters and LFOs and . . . well, you get the picture.

Now the problem. It only works with CV/gate synths, not MIDI, and how many CV/gate synths do you see nowadays, hmmm?

What you do see is MIDI, MIDI, everywhere (aside from the Oberheim Xpander, which handles MIDI *and* CV/gate). Over the years, though I absolutely hated to do it, my Lyricon retreated to the sidelines in favor of straight keyboards.

Finally, about a year ago, JL Cooper offered a ray of hope. Jim Cooper and his people have established an enviable track record in coming up with MIDI products that meet special needs, so when I heard about their MIDI Wind Driver (MWD) my excitement was almost too much to hold in. At last—someone remembered!

As it happened, my initial excitement was premature. The first version of the MWD interface was neither friendly nor expressive . . . even after much tweaking and adjustment of it, the Lyricon, and the MIDI synths I had available. Two culprits were at fault:

Enemy of the Player #1 was MIDI itself, which suffers to a degree from its origin in a keyboard-dominated industry (worse still, an industry increasingly driven by concerns for the least common denominator). The data structures in MIDI carry keystrike information quite nicely, thank you, but undergo considerable strain when asked to carry as many continuously changing streams of information as are inherent in an expressive woodwind performance (or guitar, for that matter; see Jim Wright's article in this issue).

Enemy of the Player #2 was the MWD software, which hadn't accounted sufficiently for the problems mentioned just above, and had made some rather limited choices—it only let you bend notes upward, for example. All told, it made trying to play MIDI synths with woodwind skills an unpleasant experience, and brought a whole new (and depressing) musical meaning to the word "chops."

I am, therefore, extremely pleased to report from personal experience that the latest version of the MWD (Software Version 1.6) is wonderful. They've aced it on the software level very nearly as well as anybody may ever make MIDI cope with woodwind work, and as a result I have (A) bought one, and (B) returned the Lyricon to a position of immediate and easy reach.

Here's how to put together a woodwind MIDI system. First, take one Lyricon

Wind Driver (see the end of this article for information on availability). Second, take one MWD interface box. Add four cables with ¼-inch plugs on either end, and one MIDI cable. The first cable runs from the PITCH2 output on the Lyricon to the PITCH input on the back of the MWD; it supplies the MWD with a pitch-related voltage that can be interpreted and converted into a MIDI note number. The second cable runs from the Lyricon's LIP BEND1 jack to the MWD's BEND, the third from WIND1 to WIND, and the fourth from WINDGATE1 to GATE; the voltages from these give the MWD the information it needs to recreate woodwind-style attacks, volumes, and bends within the stream of MIDI data it sends out.

I have to stress that word "recreate." Some intricate games are going on here. For example, when you breathe at a level strong enough to send a gate signal from the Lyricon to the MWD, the processor in the MWD looks at all four lines of incoming CV information and makes some necessary decisions. First, your wind pressure at the moment the gate signal is transmitted sets the note's volume level. By itself this would make for pretty dull stuff—just a lot of notes that sound but don't have any variation within themselves after they are triggered. To improve this, the MWD does two things. First, it sends out variations in wind pressure as a continual stream of aftertouch data. *If* your synth can receive and use aftertouch information, this gives powerful expressive possibilities (for example, when used with a DX7 you could change either—or both—volume or filtering with your breath simply by setting EG BIAS to ON, specifying a high amplitude range, and then selecting amplitude modulation sensitivity on one or more operators in your algorithm). And to create the effect of legato playing, all you have to do is keep blowing while fingering new notes; the processor will send out the new NOTE ON, wait about five milliseconds, and then send a NOTE OFF for the previous note, thus blending their starts and stops.

That latter effect is most persuasive when using a synthesizer that has a MONO mode (like the Xpander), so that the *synth* can be set to know it's supposed to change pitch without giving the new note an attack. This brings up a very important point: You *must* know your synth's MIDI setup. The MWD will do great stuff for you, but not if the receiving synth is ignoring the data being sent. Be prepared to do a lot of tweaking, and be consoled that after initial setup most of the adjusting will be in your synth parameters and voices, not in the MWD.

For woodwind players who want to crash through into the land of chords, there are easy-to-operate HOLD and CHORD pushbuttons. Step on HOLD while playing a note, or series of notes, and they do just that—infinite sustain. Release the button and solo against them. When you want to change the set or shut them down just step on the button again. CHORD is trickier but likely even more useful. Step on this, then keep it down while you play a note, or notes. You won't hear anything while the button is down, because the MWD is storing the notes into its memory. Now when you let the button up and play you'll produce parallel intervals instead of single notes, until the button is pressed again. (CHORD takes some getting used to because it always takes its interval from a standard reference note of C; I'd like to see a version with a memory buffer that lets you create your interval based on the last note played before the button was pressed, or perhaps a version in which you simply entered all the notes in the interval, starting with the root note to which you wanted everything to relate.)

Complaints? No serious ones, now that I've gone through the process of adjusting the MWD and my Lyricon so they work well together. (That process was a bit of a strain, by the way, in part due to flaws in the Lyricon's electronics that let wind pressure voltages bleed through into the pitch voltage circuitry.) I might wish for slightly better documentation, since there's no excuse for not rewriting an eight-page manual instead of sticking a one-page "ignore-all-references-to-X" update at the end of it. And I might wish some of the internal DIP switch settings—for MIDI output channel, choice of aftertouch or breath controller codes, and pitch bend up vs. pitch bend down—were on the outside of the box in easy reach (*especially* the bend switch!).

But these are minor caveats. For woodwind players, the most important point is that if you have a Lyricon Wind Driver (or another wind controller, such as the Steiner or the Gentle Electric), you owe yourself an MWD. And if you don't have a wind controller . . . I feel this box justifies buying one.

(Note: Lyricons are hard to find, but try contacting John Dornes at 69 Mercer Street, New York, NY 10012; tel. 212/966-5289. He bought out Computone's entire remaining stock when they went under, and there are about 50 left.)

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An electronic musician looks into one of the first MIDI data processing programs. . .and likes what he sees.

Dr. T's Echo Plus

BY CHARLES WILLIAMSON

Technology has thrown computers right into the laps of musicians, and it is becoming more and more apparent that some musicians don't care for this at all. Perhaps it's because computers carry a stigma of video games and boy-genius hackers; or maybe they represent a trend (i.e. ascendancy of the machine) that is contrary to the sensibilities of many artistic types.

I suspect that this tinge of computerphobia may explain the personality of the first wave of MIDI software. The tendency on the part of the software authors has been either to turn the computer into something the musician is familiar with (such as a multi-track tape recorder), or to keep the computer out of the picture as much as possible so that the musician need concentrate only on the instrument, not the computer. These approaches to software design are not without their recommendations, but they are fraught with severe and unnecessary limitations. In fear of confusing us with too many options, many programmers are making artistic decisions for us. As a result, we are accumulating lots of programs that are written for the least common denominator, yet are not necessarily *ideally* suited for anyone.

Thankfully, out of this mass of ho-hum software there have been a few striking exceptions to the trend—in particular, programs that are versatile enough to allow themselves to be configured to the particular needs of the user. One such program is Dr. T's Echo Plus, written by Jack Deckard for the Commodore-64 (you will also need a 1541 disk drive, TV set or monitor, and Sequential, Passport, or Passport clone MIDI interface).

***Charles Williamson** has been an audio recording hobbyist for 15 years, and has been recording electronic music in his home studio for the last ten. His most recent production,* Music By Dead People, *features electronic music composed on a Ouija board by the spirits of the deceased. He can be reached at 1716 Stonehill Drive, Columbia, MO 65201.*

At this writing, Echo Plus, which retails for $90, has the distinction of being the only software currently distributed in the U.S. that the International MIDI Association calls "Controller" software. (Other categories that they have identified include Sequencer, Editor, Librarian, Programmer and Utility types.) With controller software, your computer manipulates MIDI data in real time, as you play. Specifically, Echo Plus will perform keyboard splits, echoing, arpeggiated chords and one-finger chords, as well as allow you to control several synthesizers from one keyboard in some very useful and creative ways. The marvel here isn't so much that it does these things, but that it does them from within a framework that is loose enough to allow a good deal of flexibility.

The disk actually includes two versions of Echo Plus. Version 1 splits the keyboard into two sections; the programmed manipulation occurs in one section or the other. You can also lock-up a pattern into an infinite loop. Version 2 can define up to four zones on the keyboard. Each zone may occupy its own space as well as overlap any or all other zones if desired. A separate MIDI channel and note sequence may be programmed for each zone. Both programs have a great deal of similarity, although there are slight differences that might make one program or the other better suited to a particular application.

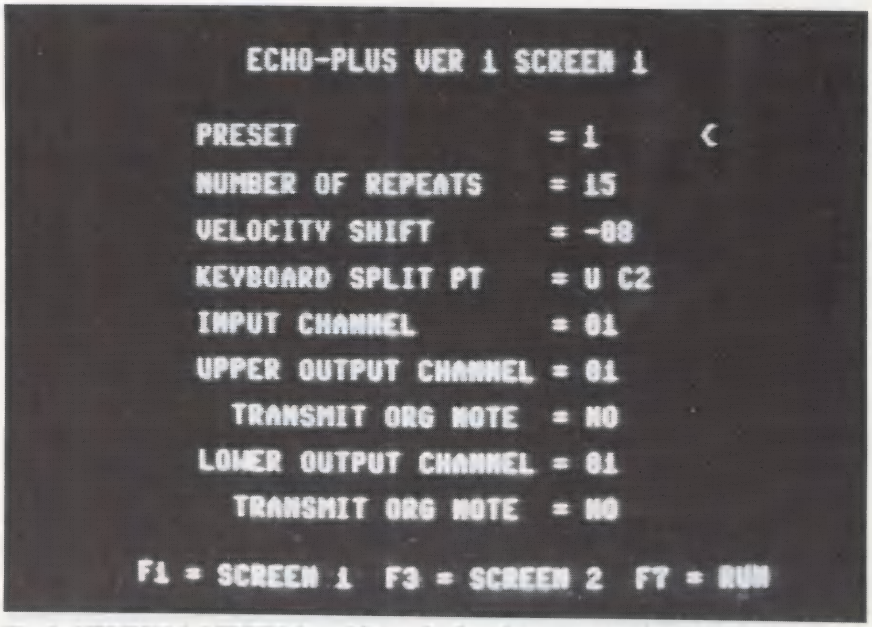
VERSION 1

Version 1 includes two screens, each of which controls different parts of the program. While viewing Screen 1 (**Fig. 1**), you enter such parameters as keyboard split point, MIDI channel assignments, whether the original note played is transmitted (this is like including the "dry" signal in a conventional DDL), and the velocity shift (i.e. change in level) for each note repetition. In the figure, the keyboard split point is C2 (second octave C). The "U" signifies that the echoes are activated in the upper split (notes above C2).

Screen 2 (**Fig. 2**) shows all of the data pertinent to the actual note repetitions. You can enter a separate delay and pitch shift value for each echo, one by one, for up to 15 echoes. Here's how you would program an echo:

✓ Enter a delay time from 0 to 20 seconds (in increments as small as .01 second). After a key is pressed, this is the amount of time that elapses until you hear the echo. Each echo can have its own delay time.

✓ Enter the amount of pitch shift. This

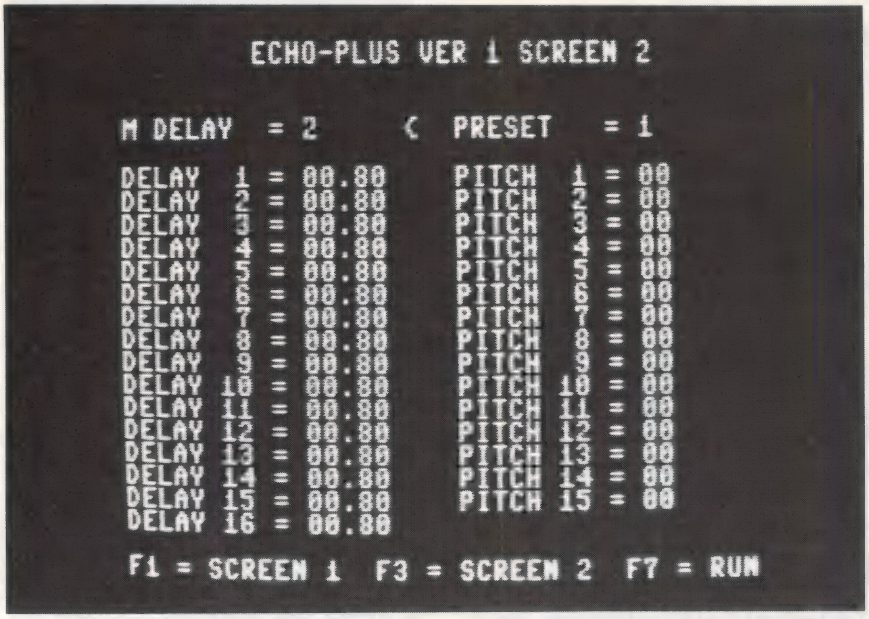


```
          ECHO-PLUS VER 1 SCREEN 1

     PRESET                 = 1       <
     NUMBER OF REPEATS      = 15
     VELOCITY SHIFT         = -08
     KEYBOARD SPLIT PT      = U C2
     INPUT CHANNEL          = 01
     UPPER OUTPUT CHANNEL   = 01
       TRANSMIT ORG NOTE    = NO
     LOWER OUTPUT CHANNEL   = 01
       TRANSMIT ORG NOTE    = NO

  F1 = SCREEN 1  F3 = SCREEN 2  F7 = RUN
```

Fig. 1: *VERSION 1 SCREEN 1 — This is the first thing you see after booting Version 1. Everything but delay and pitch parameters is set up from this screen. The keyboard split point in this case is set at C2 (second octave C). The "U" signifies that the echoes are activated on the upper section (notes above C2).*



```
ECHO-PLUS VER 1 SCREEN 2

M DELAY  = 2     < PRESET   = 1

DELAY  1 = 00.80   PITCH  1 = 00
DELAY  2 = 00.80   PITCH  2 = 00
DELAY  3 = 00.80   PITCH  3 = 00
DELAY  4 = 00.80   PITCH  4 = 00
DELAY  5 = 00.80   PITCH  5 = 00
DELAY  6 = 00.80   PITCH  6 = 00
DELAY  7 = 00.80   PITCH  7 = 00
DELAY  8 = 00.80   PITCH  8 = 00
DELAY  9 = 00.80   PITCH  9 = 00
DELAY 10 = 00.80   PITCH 10 = 00
DELAY 11 = 00.80   PITCH 11 = 00
DELAY 12 = 00.80   PITCH 12 = 00
DELAY 13 = 00.80   PITCH 13 = 00
DELAY 14 = 00.80   PITCH 14 = 00
DELAY 15 = 00.80   PITCH 15 = 00
DELAY 16 = 00.80

F1 = SCREEN 1  F3 = SCREEN 2  F7 = RUN
```

Fig. 2: *Screen 2 is where delay and pitch parameters are set for Version 1 of Echo Plus. Data is set by moving the "<" arrow to the appropriate parameter with the cursor keys, then by using the + and – keys to raise or lower the number.*

is a positive or negative number representing the number of semitones that Echo 1 will be transposed. Each echo can have its own individual pitch shift as well as echo time.

Velocity, unlike the delay and pitch parameters, is not set individually for each echo, but can be programmed to increase or decrease at a set rate. It can also be set to change randomly for each echo, which I think is an interesting option. It's too bad random changes can't be programmed for delay and pitch as well.

How the velocity, delay and pitch parameters are set up determines the personality of Version 1. No pitch shifts and a constant delay time will produce a standard echo. Setting the velocity change for a gradual fade out improves the echo effect. Setting zero delay times and appropriate pitch shifts will give you one-finger chords.

Once a series of echoes has begun, it can be locked up into endless repetition ("looped") by touching a shift key on the computer. While in this infinite repeat mode, the program does not recognize any additional MIDI data, so notes cannot be added to the loop. Hitting the space bar resumes normal operation.

All data you have programmed is stored as a *preset*. Any of eight presets can be called up instantly while in play mode. Also, groups of eight presets can be saved or recalled from a diskette. A set of eight presets can be loaded with less than five seconds disk time, a surprising feat for the notoriously slow Commodore 1541 disk drive.

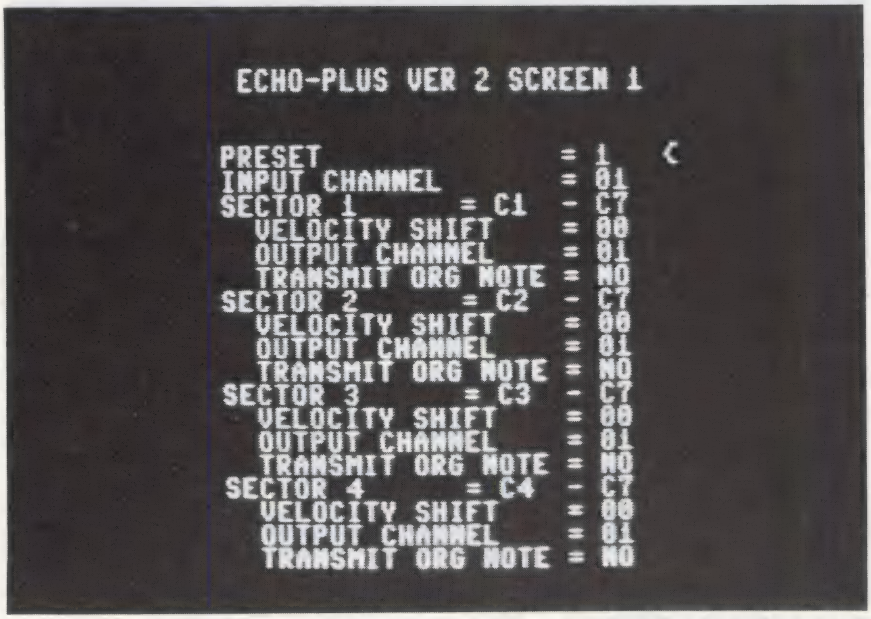
VERSION 2

Version 2 bears many similarities to Version 1, but, in this case, four zones can be defined on the keyboard, each with its own echo data, and the output of each zone is assignable to a separate MIDI channel. This version is therefore particularly useful for controlling several synthesizers from one master keyboard. **Fig. 3** shows the screen you see when setting up the four keyboard sectors in Version 2. Each sector is set independently of the others to make overlapping possible. If fewer than four sectors are desired, some can be set to CO-CO or to some other area out of reach of the keyboard being used.

To increase the overall usefulness, eight voice presets may be programmed for each echo preset. Both sets of presets are available instantly in play mode. Thus, in a live situation you would be able to choose between eight keyboard configurations (what parts of the master keyboard played what instruments), and for each configuration you would be able to choose between eight voice combinations, each voice preset sending separate voice information to each instrument. This is a wonderfully thorough bunch of options, but it's a lot to remember—even for a sober musician on a good night. The ability to name presets would be a big help here. In the absence of any mnemonic devices included in the program, extensive notes on a piece of paper would probably be

> *"This is a wonderfully thorough bunch of options, but it's a lot to remember—even for a sober musician on a good night"*

—page 70



```
ECHO-PLUS VER 2 SCREEN 1

PRESET              = 1   <
INPUT CHANNEL       = 01
SECTOR 1      = C1  - C7
  VELOCITY SHIFT    = 00
  OUTPUT CHANNEL    = 01
  TRANSMIT ORG NOTE = NO
SECTOR 2      = C2  - C7
  VELOCITY SHIFT    = 00
  OUTPUT CHANNEL    = 01
  TRANSMIT ORG NOTE = NO
SECTOR 3      = C3  - C7
  VELOCITY SHIFT    = 00
  OUTPUT CHANNEL    = 01
  TRANSMIT ORG NOTE = NO
SECTOR 4      = C4  - C7
  VELOCITY SHIFT    = 00
  OUTPUT CHANNEL    = 01
  TRANSMIT ORG NOTE = NO
```

Fig. 3: *This is the screen viewed when setting up the four keyboard sectors in Version 2. Each sector is set independently of the others to make overlapping possible. If fewer than four sectors are desired, some can be set to C0-C0 or to some other area out of reach of the keyboard being used.*

C-60: A standard audio cassette tape with 60 minutes of total recording time (30 on each side).

CD: Compact Disc; an optical-based digital recording medium whose advantages include high signal-to-noise ratio, wide dynamic range, and negligible wear.

CPU: Central Processing Unit; in a computer, the CPU functions like a brain. It interprets incoming signals and directs their execution.

GDS: General Development Synthesizer; An expensive, sophisticated synthesizer that was never widely available.

IBM AT: An advanced version of the IBM PC.

I/O: Input/Output; the sections of a computer that communicate with peripheral devices.

Mellotron: An early sampling keyboard that stored sounds on magnetic tape loops.

micro: Microprocessor; the main element of all contemporary digital computers.

PAiA: Dept. R 1020 W. Wilshire, Oklahoma City, OK 73116. PAiA has "do-it-yourself" kits for electronic musicians. Write for complete catalog.

Polyphony Publishing: 1020 W. Wilshire, Oklahoma City, OK 73116. Back issues of *Polyphony* Magazine are available for $3.00 each when shipped within the USA.

p-p: Peak to Peak; a voltage measurement that represents the potential difference between the most positive and most negative excursions of a waveform.

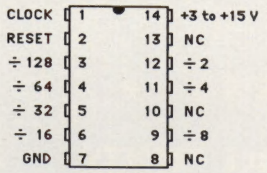
PCM: Pulse Code Modulation; a method of digitally encoding and decoding audio that yields extremely high fidelity. Typically used to record audio signals using video recorders, which provide the wide bandwidth required by digital audio.

ROM: Read-Only Memory; an unchangeable program usually permanently written into an IC's memory.

VCS3 synthesizer: Also called the "Putney," this late '60s synthesizer made by the British company EMS included a pin matrix for patching and folded up into a suitcase-sized package.

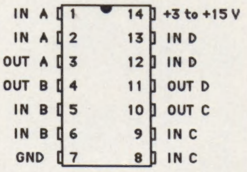
4024

7-Stage (÷128)
Binary Ripple Counter


CLOCK 1
RESET 2
÷128 3
÷64 4
÷32 5
÷16 6
GND 7
14 +3 to +15 V
13 NC
12 ÷2
11 ÷4
10 NC
9 ÷8
8 NC

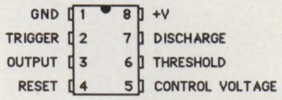
4001

CMOS Quad 2-Input
NOR Gate


IN A 1
IN A 2
OUT A 3
OUT B 4
IN B 5
IN B 6
GND 7
14 +3 to +15 V
13 IN D
12 IN D
11 OUT D
10 OUT C
9 IN C
8 IN C

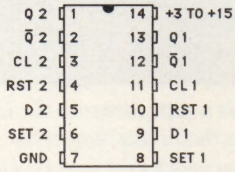
555

Timer


GND 1
TRIGGER 2
OUTPUT 3
RESET 4
8 +V
7 DISCHARGE
6 THRESHOLD
5 CONTROL VOLTAGE

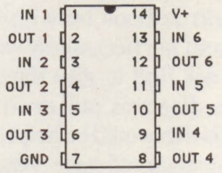
4013

CMOS
Dual D Flip-Flop


Q 2 1
Q̄ 2 2
CL 2 3
RST 2 4
D 2 5
SET 2 6
GND 7
14 +3 TO +15 V
13 Q 1
12 Q̄ 1
11 CL 1
10 RST 1
9 D 1
8 SET 1

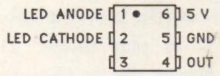
7405

TTL Hex Inverter with
Open-Collector Outputs


IN 1 1
OUT 1 2
IN 2 3
OUT 2 4
IN 3 5
OUT 3 6
GND 7
14 V+
13 IN 6
12 OUT 6
11 IN 5
10 OUT 5
9 IN 4
8 OUT 4

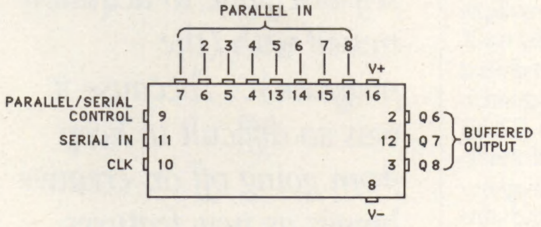
PC900

Opto- Isolator


LED ANODE 1
LED CATHODE 2
3
6 5 V
5 GND
4 OUT

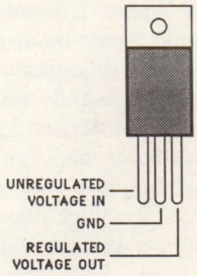
4021

CMOS 8-Stage
Shift Register


PARALLEL IN
1 2 3 4 5 6 7 8
V+
7 6 5 4 13 14 15 1 16
PARALLEL/SERIAL CONTROL 9
SERIAL IN 11
CLK 10
2 Q6
12 Q7
3 Q8
BUFFERED OUTPUT
8
V-

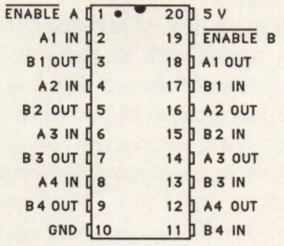
7805

+ 5v Regulator


UNREGULATED VOLTAGE IN
GND
REGULATED VOLTAGE OUT

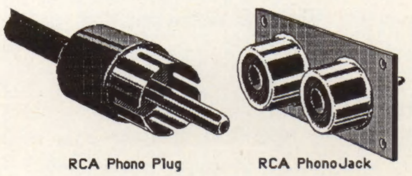
74 LS 244

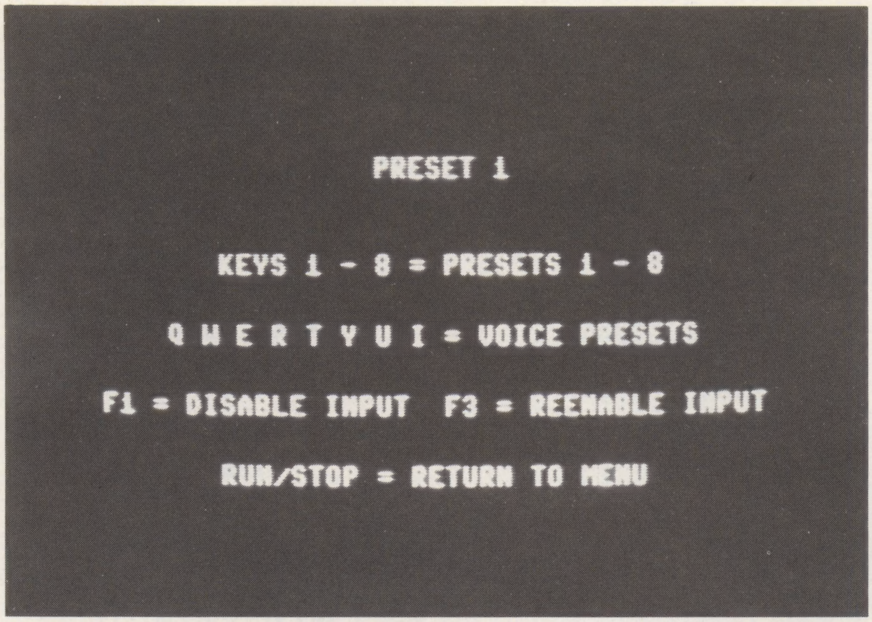
Buffer


ENABLE A 1
A1 IN 2
B1 OUT 3
A2 IN 4
B2 OUT 5
A3 IN 6
B3 OUT 7
A4 IN 8
B4 OUT 9
GND 10
20 5 V
19 ENABLE B
18 A1 OUT
17 B1 IN
16 A2 OUT
15 B2 IN
14 A3 OUT
13 B3 IN
12 A4 OUT
11 B4 IN

NOTE: With ENABLE A low, the "A" buffers are functional with LOW IN = LOW OUT and HI IN = HIGH OUT. With ENABLE B high, the "A" buffer outputs are high impedance. ENABLE B similarly controls th "B" buffers.

Correction: DataBank, in the March issue, had a glaring but common error. Four different audio plugs were pictured yet were labelled "jacks." (Below, we see that the male connector is a "plug" and the female connector is a "jack").


RCA Phono Plug RCA PhonoJack



```
PRESET 1

KEYS 1 - 8 = PRESETS 1 - 8

Q W E R T Y U I = VOICE PRESETS

F1 = DISABLE INPUT  F3 = REENABLE INPUT

RUN/STOP = RETURN TO MENU
```

Fig. 4: *This screen shows on the monitor when Version 2 is in play mode. The only actual data that is displayed is the echo preset number on the first line. The third line reminds you which keys to press for the voice presets, but doesn't display the one currently in effect.*

—from page 68, Echo Plus

needed to use this program to its fullest when playing live.

Fig. 4 shows the monitor screen when Version 2 is in play mode. The echo preset number on the first line is the only actual data that is displayed. The third line reminds you which keys to press for the voice presets, but doesn't display the one currently in effect.

Multiple synthesizers are not a necessity for Version 2; a synthesizer that can operate in mono mode and has a MIDI local control off option can do multiple keyboard splits and stacking all by itself. There are some Version 2 presets included on the program disk that are designed to demonstrate this with a Casio CZ-101 (the CZ-101 will go into local off mode, but only via MIDI command). In programming mode, Echo Plus can send this command as well as MIDI mode commands. Be forewarned, though, that MIDI implementation can vary when it gets down to the operating systems of different instruments. For example, one problem involved my Sequential Six-Trak; when in Mono mode, the keyboard outputs data on any one of six channels but the channel varies according to the key being played. Since Echo Plus will receive on only one channel, a single instrument keyboard split will not work with this model.

THE MANUAL

Microscopic best describes the type in this undersized, 16-page, photocopied booklet. Actually, all of the information you need is in the book, but it is presented only once and not necessarily where you think you will find it. Also there are no illustrations, diagrams, pictures of screens or other aids that would be helpful during the getting acquainted stage. What's there is clear and well-written, but there needs to be more.

> *"It took a great deal of self-discipline to acquaint myself with (the program). . .because it was so difficult to keep from going off on creative binges as new features were explored"*

CONCLUSION

It took a great deal of self-discipline to acquaint myself with all parts of Echo Plus, not because there was any drudgery involved, but because it was so difficult to keep from going off on creative binges as new features were explored. This program is fascinating and creatively stimulating to work with. It just may be worth the cost of the software and hardware together. . . but if you already own the computer, there is no excuse for not owning Echo Plus. EM

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prophet 2000

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